STATE LIBRARY OF PENNSYLVANIA
3 0144 00080873 3

STATE LIB.
OF PA.

Digitized by the Internet Archive
in 2016

https://archive.org/details/wildlifeeducatio00hoff

W 673a
1981

J673a
981
c.2

WILDLIFE EDUCATIONAL AIDS

by: Lou Hoffman

Revised by:
Carl Graybill
Wildlife Education Specialist

from the division of

INFORMATION AND EDUCATION
PENNSYLVANIA GAME COMMISSION

DIRECTORY

Pennsylvania Game Commission
Division of Information and Education
P. O. Box 1567
Harrisburg, Pennsylvania 17120

FIELD DIVISIONS

NORTHWEST DIVISION -
1509 Pittsburgh Road
Franklin, Pennsylvania 16323
Phone: 814-432-3187

SOUTHWEST DIVISION -
339 West Main Street
Ligonier, Pennsylvania 15658
Phone: 412-238-9523

NORTHCENTRAL DIVISION
P. O. Box 5038
Jersey Shore, Pennsylvania 17740
Phone: 717-398-4744

SOUTHCENTRAL DIVISION
P. O. Box 537
Huntingdon, Pennsylvania 16652
Phone: 814-643-1831

NORTHEAST DIVISION -
P. O. Box 220
Dallas, Pennsylvania 18612
Phone: 717-675-1143

SOUTHEAST DIVISION -
R. D. 2
Reading, Pennsylvania 19605
Phone: 215-926-3136

SECOND PRINTING

Introduction

In order to supplement environmental education curricula, the Pennsylvania Game Commission has developed a 10-day teaching unit--Wildlife and the Environment. It is designed to be integrated through various course offerings at different educational levels throughout Pennsylvania.

As an agency of the Commonwealth, the Game Commission has the legal responsibility of managing the wildlife (birds and mammals) of our state. Historically these duties began in 1895 with the creation of the Board of Game Commissioners (changed to the Pennsylvania Game Commission in 1937). Initially, our major concern was that of law enforcement and the protection of a few species; however, since that time, our coverage of the wildlife spectrum has been more comprehensive. Experience gained has enabled us to compile significant information of educational value.

This teaching unit was developed with flexibility in mind. It represents baseline material onto which supplemental topics can be linked. Upcoming topics will include predation, endangered species, birdlife, mammals, wildlife research, animal behavior and others. The daily topics are:

DAY I: The History of Wildlife Conservation (Activity)
DAY II: Wildlife in the Environment (Discussion)
DAY III: Ecological Concepts (Field Walk)
DAY IV: Wildlife Populations (Film)
DAY V: Measuring Wildlife Populations (Activity)
DAY VI: Factors Limiting Wildlife Populations (Discussion)
DAY VII: Wildlife Habitat (Discussion)
DAY VIII: Habitat Diversity and Limitations (Field Walk)
DAY IX: Wildlife Management (Discussion)
DAY X: The Future of Wildlife (Film)

Before applying the unit you will want to read these materials and consult as many references as possible, as adapting these sources to your class will require individual attention.

Also, the time allocated for each day is flexible enough for individual tailoring, but 45-60 minute periods are desirable. The two field walks (DAY III and VIII) could expend additional time, if scheduling permits. The importance of getting outside is worth the effort as variety adds to the experience. As always, planning is critical, and if possible, students are encouraged to be prepared for each day's activity.

Using the alternative activities gives even greater flexibility to the unit. Also, the films are strongly recommended but can be omitted if time is critical. Of course unrelated deviations could change the complexion of the program.

If it is not feasible to adapt the unit to a whole class you may want to consider it's application as a self-study program for only a few students. This will require close supervision but it does have potential for this application. Also, it could be used in conjunction with an ecology or conservation club.

The following source list will provide you with necessary background information and possible supplemental materials.

Andrews, W. A. (Ed.) 1974. A guide to the study of terrestrial ecology. Prentice-Hall, Inc. Englewood Cliffs, N.J. 246 pp.

Anon. 1970. Pennsylvania's wildlife conservation history, Pa. Game Commission, Harrisburg, Pennsylvania. 76 pp.

-------. 1973 Biological science: an ecological approach, B.S.C.S. green version, Rand McNally, N.Y. 740 pp.

Anon. 1974. Placing American wildlife management in perspective, Wildlife Mgt. Inst., Washington, D.C. 29 pp.

Benson, D. E. 1977. Helping wildlife: working with nature, Wildlife Mgt. Inst., Washington, D.C. 26 pp.

Doutt, J. K., C. A. Heppenstall and J. E. Guilday. 1966. Mammals of Pennsylvania, Pennsylvania Game Commission, Harrisburg, Pennsylvania. 273 pp.

Forbes, S. E., L. M. Lang, S. A. Liscinsky and H. A. Roberts. 1971. The white-tailed deer in Pennsylvania. Pennsylvania Game Commission, Harrisburg, Pennsylvania. 40 pp.

Gilbert, D. L. 1971. Natural resources and public relations, The Wildlife Society, Washington, D.C. 320 pp.

Giles, R. H. (Ed.) 1969. Wildlife management techniques. The Wildlife Society, Washington, D.C. 623 pp.

Leopold, A. 1949. A sand county almanac. Oxford University Press, Inc., New York, N.Y. 269 pp.

Luttringer, Jr. L. A. 1966. Pennsylvania birdlife. Pennsylvania Game Commission, Harrisburg, Pennsylvania. 128 pp.

Madson, J. and E. Kozicky. 1971. Game, gunners and biology..the scientific approach to wildlife management. Winchester Press. Conservation Dept., Easton Alton, Ill. 48 pp.

Pringle, L. P. (Ed.) 1967. Discovering the outdoors. The Natural History Press., Garden City, N.Y. 128 pp.

Smith, Ned. 1971. Gone for the day. Pennsylvania Game Commission, Harrisburg, Pennsylvania.

Teague, R. D., E. Decker, 1979. Wildlife conservation principles and practices. The Wildlife Society, Washington, D.C. 280 pp.

Towell, W. E. -------. Understanding wildlife. The American Forestry Assn., Washington, D.C. 20250

Troost, C. J. and H. Altman. 1972. Environmental education: A source book, John Wiley and Sons, Inc. N.Y. 575 pp.

Wingard, R. G. 1973. Wildlife resources and the natural environment. Pennsylvania State University College of Agriculture, Extension Service, University Park, Pa. 156 pp.

Many sources were utilized in preparing this unit and I would like to acknowledge a few responsible. Roger Latham wrote the History of Wildlife Management in Pennsylvania used on Day I. The reading of Day II, Wildlife and the Environment was written by Bob Wingard. The population data used on Day VIII was taken from Career Education in the Environment (Superintendent of Documents, U.S. Government Printing Office).

As a beginning we hope Wildlife and the Environment will find a niche in your classroom, and that you will evaluate these materials and forward your thoughts to us. Do not hesitate to contact us for any reason.

Thanks for caring about wildlife.

Lou Hoffman

Lou Hoffman

WILDLIFE EDUCATIONAL AIDS

from the division of

INFORMATION AND EDUCATION
PENNSYLVANIA GAME COMMISSION

DAY I: **The History of Wildlife Conservation**

PURPOSE: To familiarize the students with the history of wildlife conservation

SKILL AND ATTITUDE OBJECTIVES:

(1) To be able to recall some of the historical events that have affected wildlife in Pennsylvania.

(2) To be aware that our past history affects the thinking of our society today.

MATERIALS: Adding machine tape, colored markers, and measuring stick or tape.

READING: **The History of Wildlife Management in Pennsylvania**

Wildlife management in "Penns Woods" has followed a rather typical pattern in its 286-year history.

William Penn's Charter permitted hunting on all lands and provided for a bounty on wolves. It is interesting to note that the bounty on wolves was paid as a means of protecting livestock and human life rather than as a game management measure.

The first basic step historically in protecting, preserving and managing wildlife, specifically game, was the hunting regulation. Through seasons, bag limits and other restrictions, an attempt is made to control the annual harvest and safeguard the species.

Pennsylvania's first game law was enacted by Sir William Keith, Governor of Penns Woods, in 1721. It provided a period, January 1 to July 1, when deer could not be killed.

By 1869, other restrictions came into effect, such as prohibitions against baiting, trapping and snaring of small game. In 1873, the first comprehensive Wildlife Act was passed by the Legislature. In 1889, songbirds were given protection for the first time.

An act of the General Assembly created the Board of Game Commissioners in 1895 and six Game Commissioners were appointed by the Governor in 1896. The first appropriation for the work of game administration was made in 1897--a sum of $800 for postage only.

A non-resident hunting license was first required in 1901. The fee was $10. A resident hunter's license law was enacted in 1913 with a fee of $1. In 1915, the first two year's accumulation of money in the Hunter's License Fund was made available to the Board. The sum was $282,981.56.

Following the creation of the Board of Game Commissioners the regulation of hunting continued to grow more restrictive as the population of the State increased and as hunting pressures grew. In many ways, these restrictions reflected the responses of game populations to the clearing of the land, the introduction of agriculture, the lumbering of the forests and the building of roads, towns and cities. As wildlife populations were affected by these ecological changes, laws and regulations were designed to compensate for these various favorable and unfavorable influences.

The second step in the evolution of wildlife management procedures was predator control. Bounties were paid of the larger predators (wolves and mountain lions) and various species destructive to crops (squirrels) long before rewards were offered for the control of predators strictly as a game-management measure. But early legislators and wildlife administrators were convinced that reducing the numbers of meat-eating predators would contribute to the prosperity of game.

The "Scalp Act" of 1885, added weasels, hawks and all but three species of owls to the bounty list, thus beginning a new era in Pennsylvania game management. Some 180,000 hawks and owls were shot or trapped for bounty in the next two years.

The bounty system was retained until 1966, although wildlife scientists had been advocating its abolition for a good number of years. From 1951, when the bounty was removed from the goshawk, there was a gradual elimination of species from the list--first the weasel, then the great horned owl and finally the red and gray foxes.

The third transitional step in the development of wildlife management as a science was the game refuge system. Early officials believed that scattered refuges would provide protection from hunters for a portion of the game population and this would ensure an adequate breeding stock for the future.

Most of these first refuges were established on State Game Lands purchased by the Game Commission with hunter's license monies. The right to purchase lands was given the Commission by legislative action in 1919. The first Game Lands (No. 25-Elk County) was purchased in 1920.

At the height of the popularity of the refuge system, Pennsylvania had surrounded some 150,000 acres with a single strand of wire and appropriate signs. These 158 refuges ranged in size from a very few acres to as large as 3600 acres. The smaller ones were usually located in "farm" country and were designed primarily for rabbits, quail and pheasants. Those in the wooded, mountainous regions were for bears, turkeys and deer.

Knowledge gained by wildlife biologists over the years began to show the lack of value or lack of need, for most of these sanctuaries. Deer and turkeys increased to the point where this kind of protection for the breeding stock was no longer required. The same was essentially true for bears, pheasants and rabbits, as well. At the present time in Pennsylvania, only waterfowl seem to require refuges for security and prosperity.

The fourth management step adopted by state game departments generally was artificial propagation and stocking. The Pennsylvania Game Commission established its first game farm in 1929 and eventually operated six of these propagation plants. Game reared included bobwhite quail, ringnecked pheasants, wild turkeys and mallard ducks, plus a few other game birds and mammals on an experimental or trial basis.

Unquestionably, the ringnecked pheasant was established through the stocking of wild-trapped and farm-reared birds and the range of the wild turkey was expanded in this manner. However, research studies have indicated that, once game populations have been established, more harm than good may come from continued stocking because of the possible attendant introduction of diseases and inferior genetic qualities.

The most recent phase of the evolution of Pennsylvania's wildlife management program is that of habitat manipulation, protection and restoration. Wildlife is dependent upon its habitat--upon the proper combination of soil, water and plant life. Modern wildlife scientists have discovered the minimum needs of most common species and energetically attempt to supply these needs by plowing, planting, cutting, burning and other related practices.

Since the 1940's, a large part of the total management effort by the Game Commission has been in this direction. During the past 20 years, habitat management has become more extensive, yet more sophisticated. Through trial and error and through direct measurement, certain practices and procedures have been discarded while others have been adopted and refined. Today, predator control, refuges and artificial propagation of game are no longer considered to be vital to the survival of most wildlife species nor to the maintenance of harvestable surpluses of these species. Instead, most of the present success of the wildlife program in the Keystone State is credited to the habitat management program and to the careful regulation of the harvest.

But for any wildlife management program to be successful and practical, it is necessary for the staff to have facts and figures upon which to base their practices and decisions. These facts and figures are provided by field biologists (research personnel) through a continuous program of wildlife and habitat analysis.

Seasons and bag limits, harvest methods and regulations and land management procedures are all dictated by the findings of the technical staff and by policy decisions of the eight members of the Game Commission. This brings a high degree of competency and refinement to the modern-day operation of a state wildlife agency which is progressively changing to meet the demands of a technological society.

EXERCISE: The History of Wildlife Management in Pennsylvania

Usually, presenting the historical background of a subject, though important, is dry and poorly received by students. In order to add perspective and participation to the history of wildlife conservation, the following exercise was developed. Teams of two to four students will need a measuring stick or tape, 145 feet of adding machine tape, and color markers or pencils. When completed it may be possible to stretch the tape around the classroom allowing better utilization of the results. Early dates are rather arbitrary and subject to debate; however, they will serve as references. For a more complete account, consult the booklet "Pennsylvania's Wildlife Conservation History" available from any commission office.

Begin by drawing a reference line at one end of the tape. Let this represent the rise of modern man (Homo sapien). From there measure (scale 1 year=1/16 inch) and mark off those dates listed. It is suggested that the students be required to make the simple calculations, thereby involving them more fully. The exercise can easily be converted to metric measure if this is of corollary value to the students.

DATE	HISTORICAL EVENT
25,000 B.C.	Arrival of modern man (Homo sapien).
4000 B.C.	Moses, in the Book of the Covenant, makes first mention to wildlife management*
1215 A.D.	Magna Charta-reference to wildlife
1683	First bounty on wolves in Pennsylvania.
1721	Close season for deer in Pennsylvania.
1867	Last native elk killed in Pennsylvania.
1869	Baiting, trapping or snaring of Game birds forbidden.
1878	Unlawful to kill waterfowl with swivel or punt gun.
1895	Board of Game Commissioners established
1901	Non-resident hunter's license first established-$10.00.
1905	Pa. first state to protect black bear.
1913	Resident hunting license required, $1.00.
1920	First State Game Lands purchased (No. 25 containing 6,288 acres in Elk Co. for $2.75 an acre).
1923	Game Commission given authority to revoke hunter's license.
1929	Game lawfully killed was made subject of larceny.
1936	First roadside menagerie law was enacted.
1937	Board of Game Commissioners changed to Pennsylvania Game Commission.
1942	Hunters urged to donate deer skins to make vests for our armed forces.
1949	Penalty for unlawfully killing of black bear increased from $100 to $200.

1951	Bounty removed from goshawk.
1954	Bounty removed from weasel.
1959	Hunter Education Safety Program established.
1960	Statewide radio communications system inaugurated.
1963	Hunting license fee increased to $5.20 for residents.
1965	The millionth acre of State Game Lands purchased in Venango Co.
1966	The Commission removed the payment of all bounties.
1965 thru 1970	Project 70 provided the Game Commission with five million dollars from the State bond issue to acquire land.
1967 thru 1977	Project 500. A $125 million State bond issue for the development of recreation, conservation and reclamation projects.
1976	"Sport" program established.
1980	Mandatory fluorescent orange law for woodchuck, bear, and most deer hunting.

** "If a bird's nest chance to be before thee in the way, in any tree or on the ground, with young ones or eggs, and the dam sitting upon the young, or upon the eggs, thou shalt not take the dam with the young: thou shalt in any wise let the dam go, but the young thou mayest take unto thyself; that it may be well with thee, and that thou mayest prolong thy days." Deuteronomy 22.6.*

Obviously, the history of wildlife conservation in Pennsylvania, though spanning more than 200 years, has been concentrated during recent times. Some salient points to be observed center around the following questions:

1. What kind of wildlife management techniques are most apparent? (Restrictive types--protective measures, of one kind or another, required by expanding human activities into shrinking wildlife habitats.)

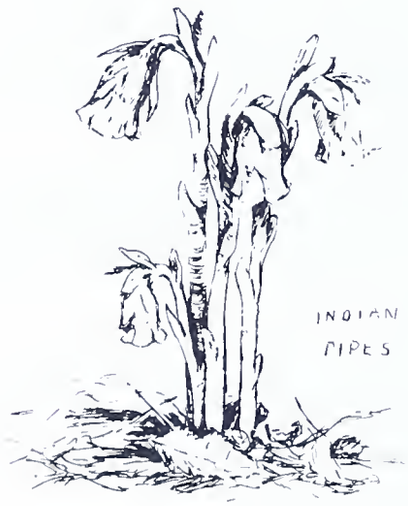
2. What is probably the most significant historical event? (The creation of the Board of Game Commissioners in 1895--today known as the Pennsylvania Game Commission--as the legal guardian of our state's wildlife.)

3. Economically, what important event occurred early in the twentieth century? (The establishment of resident--1913--and--1901--hunting licenses. Consider the effect of inflation on the price of hunting licenses then and now. Do you think the cost of a hunting license is a "good buy"? Resident license costs: 1913-$1; 1923-$1.25; 1927-$2; 1949-$3.15; 1963-$5.20; 1972-$6.70; 1973-$8.25).

4. Why were bounties so prevalent in the past? (Economic misunderstanding, bias and prejudice).

5. What event will have one of the greatest impacts on future hunters? (1959--better education of future sportsmen).

6. Speculate on the future of wildlife in Pennsylvania. (Open-ended discussion.)



DAY II: Wildlife in the Environment

PURPOSE: To emphasize the environmental interdependence of living systems (man included).

SKILL AND ATTITUDE OBJECTIVES:

(1) To be able to explain the interaction of living systems in the environment.

(2) To be aware that the type of environment affects the kinds and numbers of wildlife found therein.

READING - Wildlife and the Environment

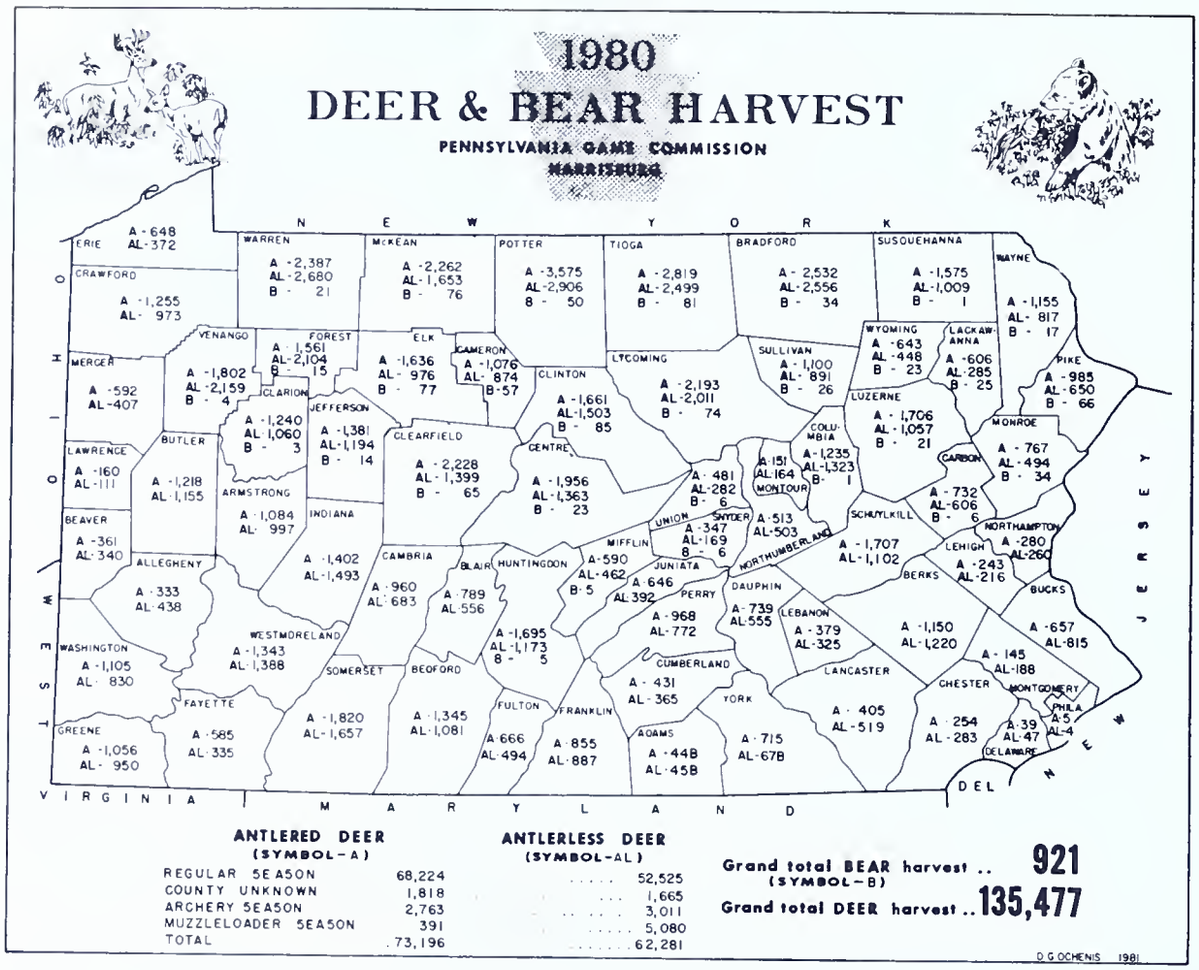
Each species of wildlife is part of a natural community, which includes many kinds of animals and plants--all interrelated, all interdependent.

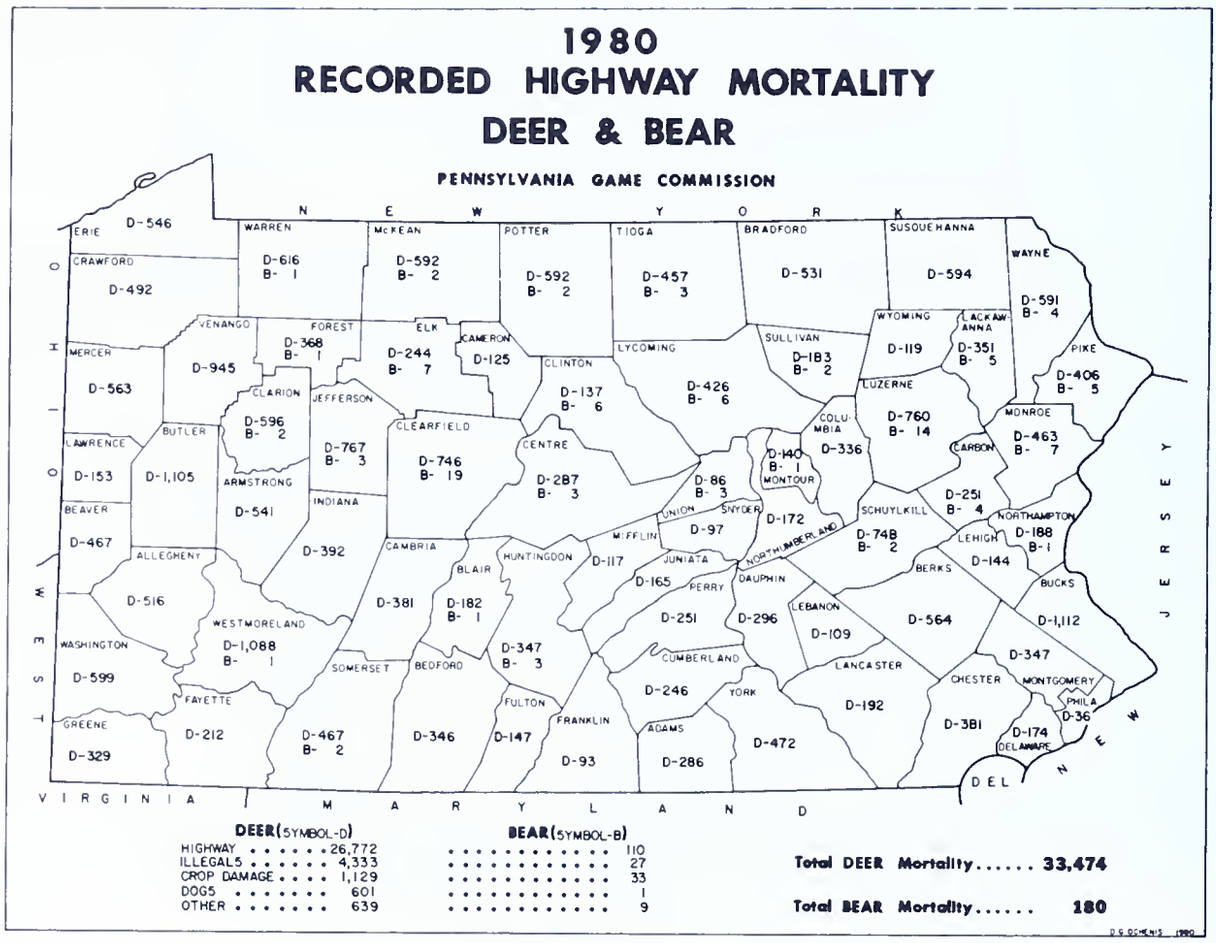
It is not possible to discuss in detail the environmental problems of one or even a few species. We must consider the place of the animal in the wildlife community, and its relationship to other animals and plants in the environment. The study of communities, the relationships going on within them, and conditions affecting them is called "ecology."

The wildlife of an area are part of large, complex, and changing natural communities which vary greatly. The dynamic characteristic of wild communities is one reason why wildlife management is so challenging and interesting. This variety is also the basis for many of the pleasures that people derive from our wildlife resources.

Of critical importance are those characteristics of any wildlife species which ensure its continued existence. Environmentally, each species must find adequate food, shelter and living space to successfully occupy its place in the complicated scheme of nature. Wildlife communities are sometimes regarded as a jumble of unrelated organisms. This is not true. There exists in these communities a high level of organization that varies according to time and space. However, complete balance does not exist, as wildlife communities are ever changing. But while the so-called balance of nature is a myth, under fairly uniform conditions a dynamic equilibrium may exist. Wildlife populations in a community are like a flotilla of boats, each trying to maintain a straight course through waters that have variable tides, currents, eddies and surface winds. Usually they are on course only when they are crossing it, and their positions, in relation to each other, are constantly changing. This dynamic characteristic of communities requires alert and careful observation to note the effects of ecological forces.

Populations that fluctuate greatly may require attention. As an example, a decline in a deer herd resulting from severe winter starvation may be offset by increased survival the following year. However, severe winter losses aggravated by continued range depletion may be a more serious concern. Not only does it mean a reduced population, but such circumstances leave the breeding stock in poor physical condition.


1980
DEER & BEAR HARVEST
PENNSYLVANIA GAME COMMISSION
HARRISBURG
NEW YORK
OHIO
WEST VIRGINIA
VIRGINIA
MARYLAND
DELAWARE
NEW JERSEY
ERIE A-648 AL-372
CRAWFORD A-1,255 AL-973
WARREN A-2,387 AL-2,680 B-21
McKEAN A-2,262 AL-1,653 B-76
POTTER A-3,575 AL-2,906 B-50
TIOGA A-2,819 AL-2,499 B-81
BRADFORD A-2,532 AL-2,556 B-34
SUSQUEHANNA A-1,575 AL-1,009 B-1
WAYNE A-1,155 AL-817 B-17
MERCER A-592 AL-407
VENANGO A-1,802 AL-2,159 B-4
FOREST A-1,561 AL-2,104 B-15
ELK A-1,636 AL-976 B-77
CAMERON A-1,076 AL-874 B-57
CLINTON A-1,661 AL-1,503 B-85
LYCOMING A-2,193 AL-2,011 B-74
SULLIVAN A-1,100 AL-891 B-26
WYOMING A-643 AL-448 B-23
LACKAWANNA A-606 AL-285 B-25
PIKE A-985 AL-650 B-66
CLARION A-1,240 AL-1,060 B-3
JEFFERSON A-1,381 AL-1,194 B-14
CLEARFIELD A-2,228 AL-1,399 B-65
CENTRE A-1,956 AL-1,363 B-23
LUZERNE A-1,706 AL-1,057 B-21
COLUMBIA A-1,235 AL-1,323 B-1
MONROE A-767 AL-494 B-34
LAWRENCE A-160 AL-111
BUTLER A-1,218 AL-1,155
ARMSTRONG A-1,084 AL-997
INDIANA A-1,402 AL-1,493
CAMBRIA A-960 AL-683
BLAIR A-789 AL-556
HUNTINGDON A-1,695 AL-1,173 B-5
MIFFLIN A-590 AL-462 B-5
JUNIATA A-646 AL-392
PERRY A-968 AL-772
UNION A-347 AL-169 B-6
SNYDER A-481 AL-282 B-6
NORTHUMBERLAND A-513 AL-503
MONTOUR A-151 AL-164
SCHUYLKILL A-1,707 AL-1,102
CARBON A-732 AL-606 B-6
NORTHAMPTON A-280 AL-260
LEHIGH A-243 AL-216
BERKS A-1,150 AL-1,220
BUCKS A-657 AL-815
BEAVER A-361 AL-340
ALLEGHENY A-333 AL-438
WASHINGTON A-1,105 AL-830
WESTMORELAND A-1,343 AL-1,388
SOMERSET A-1,820 AL-1,657
BEDFORD A-1,345 AL-1,081
FULTON A-666 AL-494
FRANKLIN A-855 AL-887
CUMBERLAND A-431 AL-365
DAUPHIN A-739 AL-555
LEBANON A-379 AL-325
LANCASTER A-405 AL-519
CHESTER A-254 AL-283
MONTGOMERY A-145 AL-188
PHILA A-5 AL-4
DELAWARE A-39 AL-47
FAYETTE A-585 AL-335
GREENE A-1,056 AL-950
ADAMS A-448 AL-458
YORK A-715 AL-678
ANTLERED DEER (SYMBOL-A)
REGULAR SEASON 68,224
COUNTY UNKNOWN 1,818
ARCHERY SEASON 2,763
MUZZLELOADER SEASON 391
TOTAL 73,196
ANTLERLESS DEER (SYMBOL-AL)
52,525
1,665
3,011
5,080
62,281
Grand total BEAR harvest .. 921 (SYMBOL-B)
Grand total DEER harvest .. 135,477
D.G.OCHENIS 1981


1980
RECORDED HIGHWAY MORTALITY
DEER & BEAR
PENNSYLVANIA GAME COMMISSION
NEW YORK
OHIO
WEST VIRGINIA
VIRGINIA
MARYLAND
DELAWARE
NEW JERSEY
ERIE D-546
CRAWFORD D-492
WARREN D-616 B-1
McKEAN D-592 B-2
POTTER D-592 B-2
TIOGA D-457 B-3
BRADFORD D-531
SUSQUEHANNA D-594
WAYNE D-591 B-4
MERCER D-563
VENANGO D-945
FOREST D-368 B-1
ELK D-244 B-7
CAMERON D-125
CLINTON D-137 B-6
LYCOMING D-426 B-6
SULLIVAN D-183 B-2
WYOMING D-119
LACKAWANNA D-351 B-5
PIKE D-406 B-5
CLARION D-596 B-2
JEFFERSON D-767 B-3
CLEARFIELD D-746 B-19
CENTRE D-287 B-3
LUZERNE D-760 B-14
COLUMBIA D-336
MONROE D-463 B-7
LAWRENCE D-153
BUTLER D-1,105
ARMSTRONG D-541
INDIANA D-392
CAMBRIA D-381
BLAIR D-182 B-1
HUNTINGDON D-117
MIFFLIN D-97
JUNIATA D-165
PERRY D-251
UNION D-86 B-3
SNYDER D-140 B-1
MONTOUR D-172
NORTHUMBERLAND D-74B B-2
DAUPHIN D-296
LEBANON D-109
SCHUYLKILL D-251 B-4
CARBON D-188 B-1
NORTHAMPTON
LEHIGH D-144
BERKS D-564
BUCKS D-1,112
BEAVER D-467
ALLEGHENY D-516
WASHINGTON D-599
WESTMORELAND D-1,088 B-1
SOMERSET D-467 B-2
BEDFORD D-346
FULTON D-147
FRANKLIN D-93
CUMBERLAND D-246
ADAMS D-286
YORK D-472
LANCASTER D-192
CHESTER D-381
MONTGOMERY D-347
PHILA D-36
DELAWARE D-174
FAYETTE D-212
GREENE D-329
DEER (SYMBOL-D)
HIGHWAY 26,772
ILLEGALS 4,333
CROP DAMAGE 1,129
DOGS 601
OTHER 639
BEAR (SYMBOL-B)
110
27
33
1
9
Total DEER Mortality..... 33,474
Total BEAR Mortality..... 180
D.G.OCHENIS 1980

Another example of problems requiring diagnosis and action is an extreme variation of one environmental factor, or the unusual combination of several factors removing some vital need of a species, such as loss of food and cover. If this food or cover is of the type that can recover quickly, the problem will likely correct itself. But if the food and cover responds slowly, something that will speed up habitat restoration is needed.

The remedy may sound easy, but analysis of the factor or factors contributing most to the change is not easy. The intricacies of the relationships which exist in a wildlife community are complex. Sound management techniques are needed to cope with environmental problems.

Questions:

1. What does dynamic equilibrium mean to you? (These are the day-to-day changes in the environment. But over a longer period of time, the "mean change" is fairly constant. Of course, in a deteriorating environment, the "mean change" is moving in a negative direction.)

2. Using the 1980 "Recorded Highway Deer and Bear Mortality," and "Deer and Bear Harvest" charts, answer the following questions pertaining to wildlife (deer and bear) and their environment. A map showing the geological features of Pennsylvania will be useful.

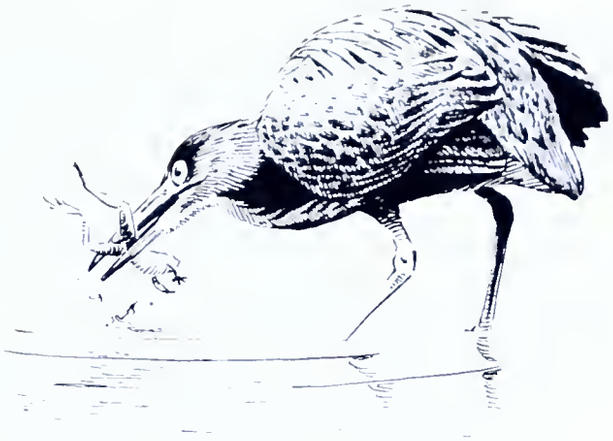
   a. Where would you expect the highway road kills to be the greatest? (Where the population centers and major highways are located--consult a State Highway map)

   b. Where would you expect hunters to harvest the greatest number of deer? (In the mountainous sections of our state)

   c. Are there any sociological reasons for these mountainous regions to have high harvests since "farm country" deer populations are also high in some areas? (The great concentration of summer cabins and hunting camps in the more remote sections--Potter Co., Elk Co., Cameron Co., etc. - account for high hunter densities as the "hunt" becomes a matter of family tradition and not just an attempt to harvest a deer)

   d. Compare the geographic locations of the bear harvest with the human population densities of these areas. What conclusion can you make? (Black bears need relatively remote areas to live)

   e. Construct other preliminary observations about wildlife and their environment from these data, and discuss the validity of such.



DAY III: **Ecological Concepts**

PURPOSE: To look at the structural components of an ecosystem and illustrate those units through a local field walk.

SKILL AND ATTITUDE OBJECTIVES:

(1) To recognize the structure and function of the basic units of an ecosystem.

(2) To recognize how ecosystems can be diverse in composition, yet similar in structure and function.

(3) To be aware that ecological concepts apply to all living systems--including man.

ACTIVITY: **Field Walk**

Make arrangements to take the class into the field in order to point out the basic units of an ecosystem. If possible, select a field, stream, woodlot or even a combination of these environments to highlight your trip. Regardless, do not overlook even the school grounds (weeds in sidewalk, starlings, house sparrows....) as a source for this activity. The apparent elementary design of the exercise is to emphasize the basic structure and interdependence of an ecosystem. Understanding these principles is paramount to understanding the great complexity of our biosphere. Also, look for ways in which man affects different ecosystems. Is man a natural part of an ecosystem? Each student should have a note pad to list examples of these key terms:

biotic community	decomposers (heterotrophs)
abiotic factors	food chain
producers (autotrophs)	food web
consumers (heterotrophs)	habitat
first-level consumers	niche
second-level consumers	

Questions:

1. Have each student compose a paragraph describing an ecosystem using the examples experienced during the field walk.

2. Using the diagrams following the reading, insert real examples for the terms shown.

3. Construct a human food chain and food web.

4. Does man's abiotic factors affect him any differently than those of lower animal forms?

(ALTERNATIVE): **Consider the reading and move on to Day IV.**

READING: Ecological Concepts

The term ecosystem is an invention of man, and the wildlife of an area have no understanding of this concept. But to simplify our understanding of the natural world, we need to consider the terms and concepts that apply to ecosystems.

The biotic community consists of organisms (animals, plants, and protists) living in a particular habitat. Not only are these living systems dependent upon each other, but they are influenced by abiotic factors including topography, soil, sunlight, temperature, moisture, minerals, wind and similar factors. The ecosystem is the interaction of the biotic and abiotic factors in the environment. Ecosystems are diversified and may be ponds, meadows, woodlots, or even a terrarium within the school. The total ecosystems of our planet make up the biosphere, or that layer on earth where life is possible.

Although diversified, the biotic structure of an ecosystem is basically similar, regardless of the geographic location. Energy sustains the life processes within the ecosystem. The biotic community is made up of two major groups, the producers and the consumers. Light energy from the sun, the driving force of all ecosystems, is utilized by the producers through a process known as photosynthesis ("photo" meaning light and "synthesis" meaning putting together). In the process, high-energy organic compounds like glucose are produced from basic inorganic compounds, namely water and carbon dioxide. The energy manufactured by the producers is then available for other forms of life in the ecosystem. Because of their role, producers are often referred to as being autotrophic (self-feeding).

Heterotrophic (other feeding) organisms are not capable of producing their own energy source. Heterotrophs then are also known as consumers since they are the animals which consume other plants and/or animals in order to obtain their energy. Consumers may be first level consumers, which feed directly on the producers like deer and rabbits which eat vegetation; or, they may be second level consumers that feed on first level consumers like an owl feeding on a mouse, or a fox feeding on a rabbit. Higher level consumers exist in some ecosystems so that a third level consumer is possible in an artic ecosystem where a polar bear (third level) feeds on a seal (second level), that fed on a fish (first level), that fed on plankton (producers).

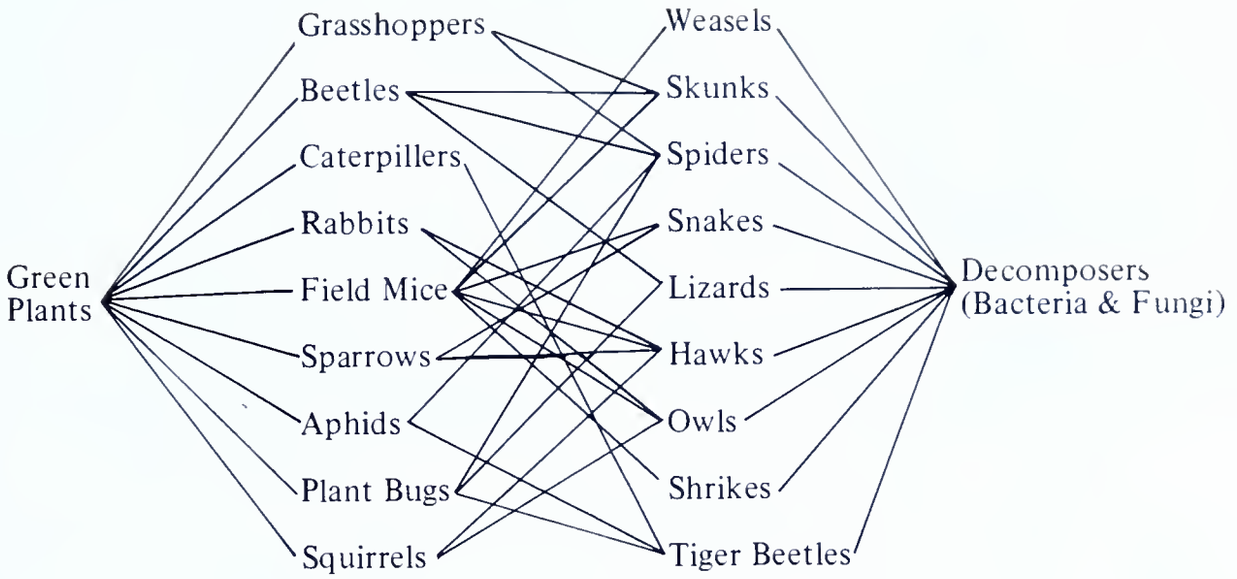
The order of energy transfer within an ecosystem is illustrated by a food chain. Food chains, however, are actually interconnected to form food webs. Since consumers (herbivores or carnivores) may feed on plants, they may fit different niches in the ecosystem. When a fox feeds on a mouse he is a carnivore, but when he consumes grapes he then becomes an herbivore. These complex patterns that occur in food webs are highly integrated relationships that occur among the biotic community within the ecosystem.

Ecosystems also contain decomposers. They are types of specialized consumers which feed on dead organic matter. Their actions return the inorganic minerals to the waters and soils of the ecosystem, making them available to the lower level producers, hence the cyclic nature of an ecosystem is enforced.

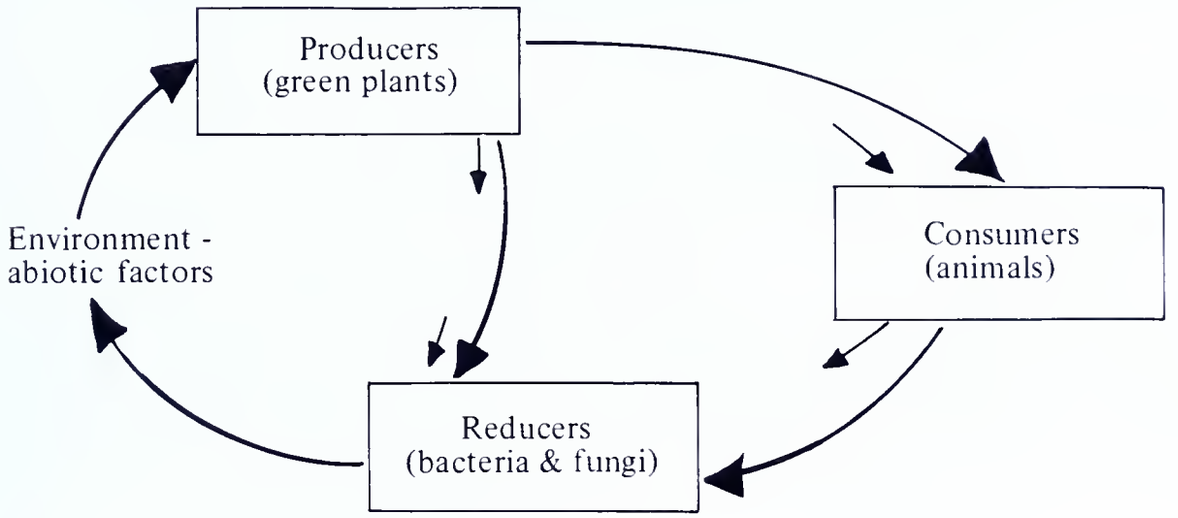
Producers, consumers and decomposers are integral parts of all ecosystems. The roles or niches of the individuals may be diversified, but their functions, regardless of the geographic location of the ecosystem, are very similar.

Another cyclic phenomenon of all ecosystems is the inorganic flow of nutrients through that system. Elements like carbon, oxygen, nitrogen, hydrogen and the compound water, are regulated by physical factors like moisture, light, temperature, wind, and the nature of the soil. These nutrients flow continuously through the ecosystem.

The following diagrams illustrate some of the concepts we have just mentioned:



Food Web - A conglomerate of possible food chains within an ecosystem.



Ecosystem Mechanics -

Cyclic flow of materials and energy in an ecosystem.

Food Chain - A step-by-step energy transfer in the ecosystem.

DAY IV: Wildlife Populations

PURPOSE: To consider a wild population and how it relates to the ecosystem.

SKILL AND ATTITUDE OBJECTIVES:

(1) To be able to define a population and cite examples of such.

(2) To recognize that populations are not static and fluctuations are natural.

(3) To realize that population growth cannot continue unchecked.

MATERIALS:

Film - "Population Ecology"	Encyclopedia Britannica Film Department of Education Bureau of Instructural Services Film No. MP2-2144

ACTIVITY: Film - "Population Ecology"

"Population Ecology" is available from the Bureau of Instructural Support Services through local Intermediate Unit Nos. 2, 4-9, 12, 14, 19-28. It is film number MP2-2144. It covers the structural mechanics of populations, and would complement Day IV. The film can also be obtained from Encyclopaedia Britannica Educational Corporation, 425 N. Michigan Ave., Chicago, Ill. 60611. A $16. rental fee is charged for a three-day viewing period.

READING: Wildlife Populations

Populations refer to the number of individuals of a particular species. They are measured over a given area (trees per acre, deer per square mile), and are seldom stable. Population changes are the result of natality (birth rates), mortality (death rates) and dispersal. The two types of dispersal include immigration (individuals moving into an area) and emigration (individuals leaving an area).

Changes in the ecosystem may force populations to disperse seasonally. These changes may be the result of abiotic and biotic factors. Migration is a common type of seasonal dispersal.

Organisms with high natalities usually have high mortalities (insects, fish, amphibians); those with low natalities also have low mortalities (birds and mammals). Biomass is a term used to describe the amount of living material (dry weight) present in an ecosystem. The standing crop is the amount of biomass present at any particular time. Biomass is used in measuring growth. It is greatest at the end of the growing season and least prior to the growing season. The animals of an ecosystem make up an almost insignificant amount of biomass with the bulk being made up of plants.

Food supplies, created by the producers, limit the populations of predatory and prey species. Crowding limits population growth. It is usually counteracted through some limiting factor such as disease, drought, or lack of a suitable energy supply.

Although populations include many individuals, single members of a population do stand out through natural selection. The four basic concepts to keep in mind are (1) overproduction, (2) competition, (3) individual variation, and (4) survival of the fittest.

All populations produce more individuals than can possibly survive in an ecosystem. The more primative the animal, the more overproduction is evident. For example, invertebrates produce hundreds of thousands of eggs, the lower vertebrates normally produce hundreds of eggs, and the higher vertebrates (birds and animals) usually produce a dozen or less offspring--with some exception.

Since overproduction is a natural phenomenon, competition for survival becomes evident. Competition for food, living space, water, and other biotic and abiotic factors necessary for survival is very real.

Within the population individuals vary because of sexual reproduction. During meiosis (sex cell production) the genetic combinations that are produced are infinite. These genes form the potential individuals of any population, and the variations, either obvious or subtle, will occur periodically.

Those individuals, because of variation, that are most adapted to survive the competition brought about by overproduction are most likely to survive. Simply stated this is known as "survival of the fittest". This oversimplification is a brief attempt to explain the interactions of a population within the ecosystem.

Questions:

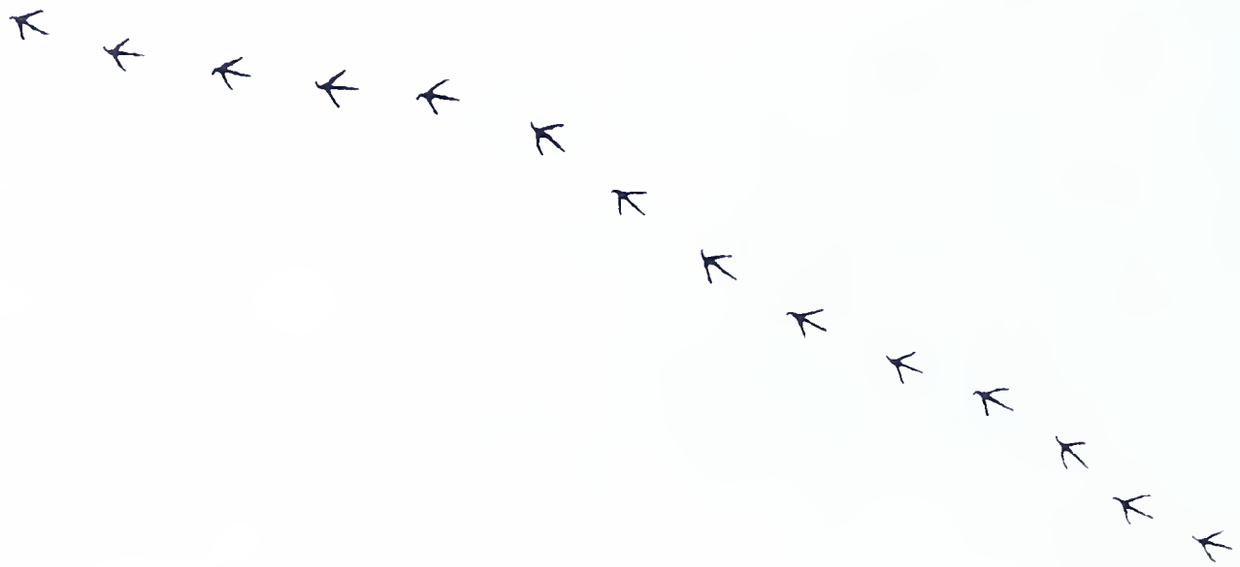
1. How do human populations compare to these discussions?

2. Consider the Malthusian theory. Does it have merit?

3. What species of wildlife is especially troublesome because of excessive population levels? (The white-tailed deer can become a nuisance to farmers because of crop damage, and a threat to drivers in the Commonwealth. Last year--1980--26,772 deer were reported killed on our highways.)

4. At what time of the year are wildlife populations most likely to experience undue hardships? (During winter months--because of a lack of food and cover.)

5. FOOD FOR THOUGHT - Will the booming human population be limited by reduced natality or by increased mortality?



DAY V: **Measuring Wildlife Populations**

PURPOSE: To familiarize students with the problems associated with censusing a wild animal population.

SKILL AND ATTITUDE OBJECTIVES:

(1) To be able to solve the mathematical equations associated with the exercise.

(2) To be able to apply the model to a real population and discuss the problems involved.

(3) To be aware of the difficulties in trying to measure the size of a wildlife population.

MATERIALS: Poker chips (200-300/group); masking tape; plastic bag (bread bag); pencils and paper.

EXERCISE: **Measuring Wildlife Populations**

This activity should acquaint you with the nature of the problems confronting wildlife biologists working with natural populations of animals. Knowing the size of a population is a common problem confronting biologists. By making use of a model, this exercise will demonstrate a common field technique used to estimate wildlife populations. It is called the Lincoln Index. Keep in mind it reflects only an estimate and does have limitations.

Work in groups of 3-5 students. Poker chips, representing cottontail rabbits, will be placed in a plastic bag representing farmland. First "capture" a handful of rabbits. Naturally; you did not collect all of the rabbits, but those you did will be marked with a small piece of masking tape. Next, count the number of rabbits you captured. Thirdly, replace the rabbits to the fields and mix them evenly with the rabbits you did not initially capture. Now make another sample of the rabbit population and record these two things--the number you captured the second time (total), and the number of these animals that were marked with the tape. Now using your data, apply it to the following formula:

$$\frac{N}{M} = \frac{n}{m}$$

Where: N=total population (N)

M=Number of individuals captured, marked, and counted the first time (53)

EXAMPLE:

$$\frac{N}{53} = \frac{62}{21}$$

n=The total of the second catch (marked + unmarked) (62)

m=The number of individuals marked in the second catch (21)

Solve the equation for N. Show your values and work:

$\frac{N}{53} = \frac{62}{21}$;

$21N = 3286$

$N = 3286/21$

$N = 156.5 = 157$ rabbits

Finally, count the number of rabbits actually present, and compare it to your estimate.

ESTIMATE 157 ACTUAL COUNT 185* PERCENT ERROR −15.1%

ACTUAL (185) — ESTIMATE (157) = DIFFERENCE (28)

$\frac{\text{DIFFERENCE (28)}}{\text{ACTUAL (185)}}$ = ERROR (−15.1%)

**Actual chips in bag*

Questions:

1. Can you assume each and every animal has the same likelihood of being captured? Why? (No, differences in sex, age, cover, distribution of traps, and other variables affect the accuracy of the study.)

2. What other variables would complicate the study? (Immigration and emigration, weather, uneven mixing...)

More important than a single estimate, is the establishment of a trend for the population over a period of time. Significant deviations from this trend are what wildlife biologists monitor.

Realizing that some classes may want to treat this subject in detail, a more thorough analysis of the problem can be found in *Wildlife Management Techniques*. (Ch. 21-22, pp. 403-497).

DAY VI: Factors Limiting Wildlife Populations

PURPOSE: To illustrate the natural limitations of a wildlife population.

SKILL AND ATTITUDE OBJECTIVES:

(1) To be able to describe the basic factors (living and non-living) that limit wildlife populations.

(2) To learn to accept these factors as being neither good nor bad--but natural.

(3) To be aware of the reality of life and death in an ecosystem.

MATERIALS: Film "Wood Ducks World"

Available from your local District Game Protector or Ducks Unlimited, Film Dept., Box 66300, Chicago, Ill. 60666 ($6.75)

ACTIVITY: Film "Wood Ducks World"

The film follows a brood of yound wood ducks through their first months of life illustrating the limiting factors (genetic deficiencies, predation, hunting) facing the species. A good seasonal presentation of a colorful bird.

Questions:

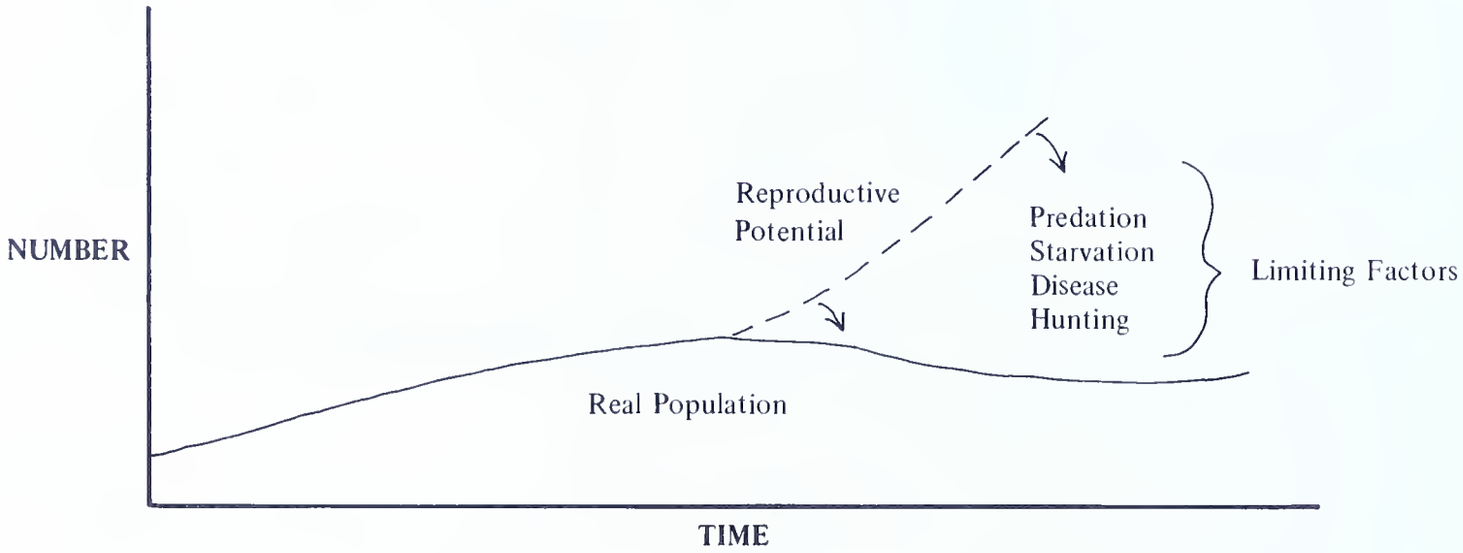
1. Predatory niches (functional role or ecosystem "occupation" of an organism) are highlighted. As ducklings the snapping turtle is a threat; as flightless, but terrestrial birds, ground predators may take their toll; and, as adults, a peregrine (endangered species) may occasionally take a wood duck. Comment on these occurrences.

2. What other limiting factors affect wood duck populations? (nesting sites--natural cavities or artificial sites--parasites, wetlands, disease, and a host of abiotic factors).

3. In making wildlife films some "artificial" treatment may be necessary to secure the proper footage. Emphasize that TV programs do the same. See if the students can spot any of these scenes.

READING: Factors Limiting Wildlife Populations

Limiting factors are those factors in the environment that reduce the reproductive potential of a population. Graphically, it may be illustrated like so:



Plants are limited also, by soil types, moisture, nutrients, light, etc., and as producers, ultimately affect the energy available for the consumers. No living system can escape these limiting factors.

Each ecosystem then has a built-in carrying capacity, which is determined by the sum of the environmental factors (biotic and abiotic) that limits the population density of that system.

(Alternative): Natural History Study

Involve a small group of students in a natural history study of any wildlife species. This should include research and a class presentation. Consider its description, range, feeding and reproductive behavior, and habitat relationships. Consider ways in which the habitat is changing (shrinkage, expansion, pollution) and the affect it will have on the species in question.

Other questions to consider:

1. What is the specific habitat requirement of this species?
2. What are the principle limiting factors affecting the species?
3. Is the species compatible with man?
4. What is the future of the species?
5. What can man do to ensure the future of the species?
   Are these suggestions practical?

Following are a few pages pertaining to the natural history of several species which could be incorporated in this lesson.

WILDLIFE NOTES

by: Chuck Fergus

COTTONTAIL RABBIT

BIOLOGY

The cottontail rabbit is probably our most popular small game animal, and it is also the wild animal most often seen in towns and suburban areas. Because of its popularity and conspicuousness, the rabbit arouses interest in hunters and non-hunters alike. The cottontail rabbit is a long-eared, small- to medium-sized mammal of the family Leporidae. It hops when running, as its hind legs are longer than its front legs. Its soft fur is brownish above and white below, it has a conspicuous two-inch-long white tail, and some individuals have a small white blaze on the forehead. Cottontails are 15-18 inches long and weigh two to three pounds; females are slightly heavier than males. Preferred habitat includes swamps, thickets, briar patches, down-timber, weedy fields, brushpiles, overgrown fencerows and brushy gullies. Feeding areas are rarely very far from good cover. Rabbits seldom dig dens, preferring to occupy abandoned woodchuck burrows. Home range may be ¼-20 acres, depending on the availability of food and cover. An individual rarely leaves its home territory, where it knows food sources, cover and escape routes thoroughly. Summer foods include leaves, herbs, legumes, fallen fruit, garden vegetables, low broadleafed weeds, clover and grass; captive wild rabbits have eaten grass equivalent to 42% of their weight daily during the summer. In the winter, cottontails eat blackberry and raspberry canes, bark, buds, tender twigs of brushy plants and poison ivy vines. A rabbit possesses sharp hearing and a keen sense of smell. Its eyes are set well back on the sides of its head, providing a wide field of vision. Rabbits are basically nocturnal, feeding in the evening, at night, and in the early morning. Individuals shelter in thick brush or an abandoned woodchuck burrow during the day, and they lead solitary lives on their home ranges. Rabbits rely on a burst of speed and a zigzagging running pattern to evade predators, but they cannot run steadily for long distances. They can swim if they have to. Cottontail litters are usually born from March through September, with about half being born in May and June. Litter size ranges from two to nine young, with five the average; the gestation period is approximately 28 days. Each mature female bears an average of four litters per year. Juvenile females born in the early spring are sexually mature--and often breed--by late summer of the same year. A cup-shaped hole about five inches across and four to six inches deep serves as a nest. The nest is lined with dried grasses and fur, which the female plucks from her chest and belly. Young are born blind, naked and helpless, but they are weaned, fully furred and on their own at the age of 16 days. The male takes no part in raising the young. Predators, spring floods, heavy rains and farming operations are the major causes of nest mortality. Few cottontails live to be more than a year old in the wild, although their potential lifespan is three to four years. Rabbits are a major food source for many other types of wildlife. Like other heavily-preyed-upon species, rabbits have an extremely high reproductive rate which maintains adequate populations.

POPULATION

The rabbit population today is not as large as it was in the past. The main reason for this decline is loss of good habitat. Today's modern equipment lets farmers clean up and cultivate fence rows, swamps and brushy slopes that once held many rabbits. Expanding cities and towns, new roads and dams continually reduce habitat. Around the turn of the century, many forest areas were logged off. As these areas grew up in brush, new rabbit habitat was formed, accounting for the tremendous cottontail populations earlier in this century. Later, low vegetation--which supported the large rabbit populations--began to die as it was shaded out by growing trees. This natural mortality of low vegetation is a result of normal forest succession. Another factor in the decline

of rabbit numbers is that the growing deer herd out-competed cottontails for the remaining low vegetation. This loss of food and cover, in addition to predation and highway kills, makes for fewer cottontails today than in the past. Also, today's rabbits are more nocturnal than their forbearers and therefore are not seen as often. From year to year, rabbit populations fluctuate in a given area. Changes seem to follow a smooth curve, indicating a gradual building up and dropping down. Hunters usually harvest less than 30% of the available rabbits. Studies show that even if hunters take as much as 40% of the fall population, the next year's rabbit population will not be adversely affected; the species' tremendous reproductive potential builds the population back up again. Young rabbits usually comprise about 80% of the population, but few live to see their second winter. In summer, when litters are being born and food is plentiful, four rabbits may inhabit a single acre. Then an apparent change in behavior takes place in the early fall, with rabbits becoming more nocturnal. Also at this time, the summer's surplus of young rabbits is thinned by disease, predation, parasites, or a combination of the three. (Biologists are working to try to explain more fully this seasonal population drop.) During the fall, one rabbit per acre is considered a good density. The population is at its ebb in late winter after hunters, predators and winter weather have taken many rabbits.

HABITAT MANAGEMENT

Habitat--also called environment, living conditions or food and cover--has more impact on the rabbit population than any other factor. Good rabbit habitat provides ample food adjacent to protective cover. Heavily cultivated land produces ample food, but not enough protective cover; on abandoned farm land, the reverse is often true. Rocky field corners, gullies, poorly drained woodland, outcrops and other areas not being farmed can be managed to produce rabbits. These areas may be planted with pines or shrubs. Cutting along woodland edges stimulates the growth of low vegetation. Brushy plants which grow in these cut-over areas provide food and cover for several years. Individuals interested in creating more summer food for rabbits can plant areas of clover and grasses. These food plots may require four or more mowings each summer to keep them in a "lawn" condition, and they should also be located near good cover. Rabbits often shelter in brushpiles. Brushpiles are best made by placing smaller brush over several firm, large logs, which provide support. The larger logs also keep the brush off the ground, preventing its rapid deterioration. These herbaceous perennials produce good cover: sericea lespedeza, switch grass, and reed canary grass. Rabbits also use lespedeza as a winter food. Shrubs that provide good cover are multiflora rose, autumn olive and tartarian honeysuckle. (The spread of these shrubs can be controlled through the careful use of herbicides.) Many conifers also produce fine cover, including white, red, Scotch, Virginia, Austrian and mugho pines, and Norway spruce. Coniferous plantings require maintenance to remain good cover areas. Information on the best methods of planting, spacing and maintaining plants for food and cover is available from the Game Commission. Ninety percent of Pennsylvania's small game is produced on private land, and the key to a larger rabbit population lies in more habitat improvement on the part of the private landowner.

RUFFED GROUSE

BIOLOGY

The ruffed grouse has been Pennsylvania's official state bird since 1931. It is a game bird well known for sporting characteristics and excellent table qualities, and its beauty is admired by hunter and non-hunter alike. The average grouse weighs around 1½ pounds, its body length is 15½ to 19 inches, and its wingspread is from 22 to 25 inches. A grouse's plumage is colored a rich brown sprinkled with white and black above, and white with horizontal dark brown bars on the breast and undersides. The tail is brown and has a wide, black band between two narrower grayish bands. The name "ruffed" comes from a ruff of iridescent black feathers that almost completely encircles the neck. Two interesting color phases occur infrequently. "Silver-tailed" birds have gray instead of brown in the tail; "red-ruffs," even rarer than the silver--tails have rust-colored feathers with chocolate-brown ruffs and a dark brown--rather than black-tail band. Males, also called cocks, differ from females (hens) in several ways. Males tend to weigh a little more than females, and the male has a much more prominent ruff, which he can fluff up for a courtship display. The hen has a shorter tail, and her black tail band is broken in the center, while the cock's band is generally continuous. Grouse moult once each year. The adults moult from July into September and may have difficulty flying when many flight feathers have dropped and replacements have not fully developed. Immature birds moult in August and September when adult plumage replaces juvenile plumage.

Grouse are members of the partridge family and are sometimes called "pats." They are found throughout our state in secluded, woody areas that provide food, cover and nesting sites. They are residents throughout the year. Individuals rarely range more than a few hundred yards a day unless pressed by predators or hunters. In fact, the same grouse may be flushed from the same area in the woods several days in a row. Grouse eat many types of food. In the summer, they consume insects (which are rich in protein), blackberries, blueberries and other wild fruits, sedges, and green leaves of various plants. In the fall, when insects are scarce, their diet is almost exclusively plant foods including small acorns, beechnuts, cherries, barberries, wild grapes, apples, hawthorn and dogwood fruits, and various buds and leaves. Buds form the basis of the grouse's winter diet: aspen, birch, beech, maple, cherry and apple buds are favored. Ferns, green leaves and other evergreen foods are eaten until food becomes more plentiful in the spring. Like most birds, grouse have keen eyesight and hearing. At one time, they were not nearly as wary as they are today; early settlers killed them with sticks and stones. However, years of hunting pressure have turned the grouse into our shyest game bird. They often take off far out of range, but may hold until a hunter is within a few feet and then thunder into the air. They bathe in dust on back roads, in sandy bare spots on the forest floor, or in the debris around a rotting stump. Dust bathing may stimulate feather growth in young grouse, maintain adult plumage, and rid birds of external parasites. Grouse take shelter on or beneath the branches of conifers during stormy weather. They also roost in hardwoods. During winter, they may spend nights beneath the snow, sometimes flying directly into a soft snowbank at dusk. Grouse are not especially gregarious; groups of the birds are sometimes found together in the fall, but these are usually a hen and her offspring of that year. During late fall and winter, grouse occasionally live in small groups (7-12 birds) that may remain together through the winter in areas of optimum food and cover. During winter, a grouse's feet develop snowshoe-like properties through the growth of a horny fringe around the toes. Although its take-off is thunderous and powerful, a grouse cannot fly long distances. Its top flight speed is about 20 m. p. h. After take-off, it flies rapidly and then locks its wings and glides to safer territory, usually traveling less than 100 yards. During mating season--March and April--male grouse attract females by drumming. With tail fanned the male stands on a large, prominent log or rock, and beats the air sharply with his wings. The rush of air created by his wingbeats sound much like drumming. The drumming starts slowly and increases in speed, until the individual thudding beats merge into a fast, steady whir. Males fight and display, or strut, for females. Displaying males fan their tails, puff out their ruffs, hiss and drag their wingtips along the ground. A mated hen picks a secluded nesting site, usually at the base of a tree or under a bush, and lays 6-16 white or buff eggs in a leaf-lined depression in the ground. The hen may renest if nest destruction occurs. The incubation period is approximately 24 days. The male does not help the female incubate eggs or brood young. Baby grouse are precocial--they can leave the nest when dry. Chicks develop rapidly. At three weeks of age they can fly, and by autumn they look and act like adults. In early fall, birds of the year may exhibit a strange period of restlessness known as the "fall shuffle" or "crazy flight." During this time, young grouse take off in apparently undirected flight, and some are killed when they crash into trees, fences, windows and the sides of buildings. Biologists believe the fall shuffle scatters broods and expands or disperses the population. After the shuffle, most young grouse are independent. Grouse rarely--if ever--die of old age in the wild. Juvenile mortality is great; most grouse die before they are a year old, and few live to be two years of age. Hunting and predation probably have little effect on the overall population.

POPULATION

Many factors affect the size of the ruffed grouse population. A cold, wet spring following a harsh, long-lasting winter results in lower numbers of successful hatches. Many females succumb to bad weather conditions while trying to incubate eggs or brood young, and chicks find it especially hard to survive cold, drenching rains. Grouse can contract diseases which may kill or weaken them, making them more susceptible to predation. Parasites affect grouse numbers similarly. Birds may die of a variety of physical accidents, including being hit by cars on back roads. Predation, severe weather and natural disasters like floods and forest fires also contribute to mortality. Hunters harvest only what biologists term "surplus" grouse, birds that would die of other causes before the next breeding season. Some game biologists estimate that hunters can safely harvest two out of every five birds present at the beginning of hunting season without endangering the next year's breeding stock. In years of good production, hunters usually take two or three juveniles for every older bird they harvest. The grouse population seems cyclic, undergoing fluctuations--from low to high numbers of birds--that span periods of five to ten years. Populations fluctuate differently in different regions, due to local cover, food, and weather conditions. Local grouse populations can be estimated by recording the number of birds flushed per hour of hunting. In general, hunting is considered poor when the flushing rate averages less than one per hour, fair when the average falls between one and two per hour, good when two to three, and excellent when over three grouse flush per hour.

From 1965-69, the statewide average flushing rate was 1.58 birds per hour. Grouse will not tolerate crowding. The minimum area needed to support a single brood is about nine acres; for this reason, grouse are hard to propagate in captivity in the numbers needed for restocking. Pennsylvania's rapidly maturing forests and a large deer herd have combined to reduce undergrowth and cover. Today, good grouse cover returns wherever forest tracts are cut over or burnt off and then grow up in brush, duplicating favorable conditions that were present after the extensive logging of Pennsylvania's forests around the turn of the century. Wildlife biologists continue to study the ruffed grouse and learn about these excellent game birds, but many questions remain unanswered.

HABITAT

Cover is the most important factor affecting the size of our state's grouse population. Cover is comprised of those physical things that provide natural shelter and protection for wild creatures; grouse need cover for breeding, feeding, wintering and especially for brooding (raising) young. Earlier in this century, much of Pennsylvania provided excellent grouse habitat in brushy, logged-off forest areas. Today, these areas have grown up, or matured, and offer less suitable low cover. Grouse are shy birds and their range has shrunk where cities and towns have expanded; they don't readily adapt to civilization. Grouse can do well in areas without visible water sources, obtaining moisture from vegetation they eat. They seldom starve during the winter, as they are capable of "budding" (eating tree buds that are available regardless of snow depth). The following plant species and situations contribute to good grouse habitat and should be encouraged: mountain laurel and greenbrier thickets, especially those including some hemlocks or white pines; prolific sprout growth in areas which have been burned or logged within the last ten years and are growing up again; dense pine clusters in immature hardwood forests; stands of wild crab and hawthorn trees; edge provided by logging roads and trails through wooded areas; and abandoned apple orchards near thick cover. Taller trees can be felled to allow more sunlight to reach grapevines, greenbriers, small conifers, thorn-apple trees and the like. Aspen stands can be managed to favor grouse. Aspen has about a 40-year life expectency and produces a maximum amount of buds at this age. A percentage of mature trees can be cut every ten years, producing four different growth stages in each stand; further segments of each 10-year stand can be cut every two years to give five ages within each stand. These practices result in a variety of age groups--from one to 40 years old. Landowners interested in building a good grouse population should try to increase the following on their property: juneberries, grapes, greenbriers and witch hazel. At the same time, they should cull out towering, shade-producing trees which may kill the more favorable low fruiting vegetation.

RED AND GRAY FOXES

BIOLOGY

Red and gray foxes are small, agile carnivores belonging to the same family (Canidae) as the dog, coyote and wolf. Both red and gray foxes are found throughout Pennsylvania. They are intelligent predators with extremely sharp senses of sight, smell and hearing (a fox can hear a mouse squeal at about 150 feet). The red is 22-25 inches in length, with an additional 14-16 inch tail, and weighs 8-12 pounds. The gray is 21-29 inches in length, plus an 11-16 inch tail, and weighs 7-13 pounds. The red has long, reddish-orange fur slightly darkened on the back, black ears, legs and feet, and a long, bushy, white-tipped tail. The gray fox has a black and gray coat, somewhat coarser than the red's, with buff-colored underfur. The gray's tail is also long and bushy, with a black streak running down its length and a black tip. Dramatic color variations may occur in individual reds, although these are rare and show up more often in the species' northern range, especially in Canada. Color variations include: the "cross fox," with a dark stripe of hair extending from the head down the center of the back and transected by another dark stripe over the shoulders, thus forming a cross-like shape; the "black fox," a melanistic red fox; and the "silver fox," simply a black individual with white-tipped guard hairs giving a frosted appearance. The red fox always has a white tail-tip, no matter the color phase or shade of red fur, which also varies slightly in individual animals. Foxes are swift runners and can swim if they have to. Both species are largely nocturnal. The gray can climb trees--it is the only member of the canine family with this ability. Foxes are "opportunists" when it comes to feeding. This means they will eat whatever is most easily obtained. Foods include mice, rats, rabbits, woodchucks, opossums, porcupines, domestic cats, chickens, insects, squirrels, game birds, songbirds, bird eggs, fruits and grasses. Foxes are also scavengers, feeding on road killed animals and winter kills. Diets of both reds and grays are essentially the same, but different food preferences, behavior patterns and preferred habitat

often result in different types and amounts of food eaten. Both species cache uneaten food by burying it in loose earth. Males are called "dog" foxes and females "vixens." In late winter, foxes can be heard barking at night, making their presence known to members of the opposite sex. Breeding usually takes place in February. Young are born following a 51-day gestation period for red foxes and a 63-day period for grays. Litters range from 4-10 young, with six the average. Young are born in dens. The red fox usually enlarges a woodchuck burrow or may den in a hollow log; the gray may also den underground or in crevices in rocky ledges. Underground dens for both species usually have several entrances. Baby foxes weigh about eight ounces at birth, and their eyes are closed for the first 8-10 days. They are nursed by the female in the den for around a month. When the pups emerge, both mother and father keep them supplied with solid food until they are completely weaned after two or three months. They leave the den area in mid-July or August and may forage with their parents for another month until the family disbands. Foxes trapped in the fall are often young ones on their own for the first time establishing new territories. Both males and females are sexually mature at ten months and may breed during their first winter. Red foxes seldom seek shelter in holes or dens during winter, preferring to sleep in the open with their bushy, well-insulated tails curled over their noses to keep warm. Grays often hole up for three or four days at a time during severe weather. Foxes may be afflicted with many parasites, including ticks, fleas, lice, mites, flukes and worms. Reds seem to be more susceptible to mange than gray foxes. Both species can contract rabies, but there have been no major outbreaks of this disease in Pennsylvania in recent years. Diseases and parasitism strike foxes the hardest when they overpopulate an area; this is nature's way of reducing a too-large population. Wildlife researchers have live-trapped foxes, tagged and released them. In New York, foxes lived an average of 178 days after tagging, and in Michigan they lived an average of 187 days after release. These figures illustrate the tremendously high mortality rate of foxes in the wild. A life span of 10-12 years is possible, however.

HABITAT

Red and gray foxes generally favor different types of habitat. The red prefers sparsely settled, rolling farm areas with wooded tracts, marshes and streams. The gray fox is more commonly found in heavy woods, swampy lands and rugged, mountainous terrain. But both species are very adaptable and can be found throughout the state, sometimes in areas not considered prime habitat. Red foxes seem less afraid of people than grays and occasionally inhabit heavily populated areas, although they are rarely seen due to their nocturnal habits. In Lancaster County, a pair of red foxes raised a litter in a hole beneath a large brush pile only 100 feet from a tennis court that was used daily. On a continental scale, both species have extended their ranges in recent years, usually in response to local habitat changes. Grays are more aggressive than reds and where the ranges of the two overlap, the gray is the dominant species. At present, gray foxes are spreading north into New England as logged-over areas and abandoned farmland grow back into mature forests.

POPULATION

Fox populations are affected by availability of food, changes in range and suitable habitat, and pressures from man. In a study made in Chester County, it was found that there was approximately one fox per 200 acres, or 3.2 foxes per square mile. Some high-use agricultural areas--with little cover for either prey or predators--had only one fox per 300 acres, or 2.1 foxes per square mile. Wooded and less heavily farmed areas had one fox per 50 acres or 12.8 per square mile, a high concentration. This same study estimated a statewide average of 1.4 foxes per square mile of suitable habitat. Fox populations can be measured by different methods, including counting droppings on the snow, den reconnaissance and tracking studies. The gray fox has much larger toe pads and a smaller foot than the red, so the two can often be distinguished by their tracks. Movements in gray and red fox populations are basically of two types. The first is dispersal, or the movement of young in late summer or early fall. Dispersal spreads the population out, with each young fox moving several miles--occasionally 50 miles or more--to set up its own home territory. The second type of movement occurs within an individual's home territory or range. From tracking studies, biologists estimate that a fox travels an average of five miles in search of food on a winter night. Populations fluctuate and shift, often as a result of human activities such as logging, farming, construction and even hunting. For instance, the gray fox is fairly easily fooled by electronic calling devices which reproduce the cry of a wounded prey animal. In areas where electronic calling is widely practiced, many grays are taken and local populations may drop drastically. Red and gray foxes may someday be classed as game animals and hunted through the use of the more sporting mouth-operated calls rather than electronic calls. Trapping, unlike electronic calling, does not wipe out local fox populations, as it is almost impossible

to trap an area out. At times, foxes may become too numerous. When this happens, local predator control--reduction through hunting and trapping--can be used to bring numbers to an acceptable level. Reduced populations are less susceptible to starvation, disease and parasitism (mange, for example). In the past, foxes have often been blamed for decreasing game populations, but most of the time the number of game birds and animals taken by foxes and other predators is insignificant compared to other natural losses. When all the facts are in, it is most often found that habitat change is the main contributor to lower population, rather than predation.

SQUIRRELS

Most Pennsylvanians are familiar with the gray squirrel, which lives in both towns and rural areas. The gray is our state's most common squirrel; the fox, red, and flying squirrel are three other tree squirrel species native to our state. Squirrels are fast and agile, scaling trees and jumping from treetop to treetop with great speed. When jumping, they use their large tails to help keep balanced. Squirrels see only in shades of black and white, but their eyes are sharp and detect movement well. They have keen senses of hearing and smell. Squirrels are most active in early mornings and late afternoons, except the nocturnal flying squirrel. Squirrels are rodents. The four species do not interbreed. Young are born blind, naked and are dependent upon their mother for up to two months.

BIOLOGY

Gray Squirrels - Adult gray squirrels weigh 1-1½ pounds and are 18-20 inches in length; about half this length is broad, bushy tail. Most grays are colored silvery-gray above and off-white below, often with rusty or brownish markings on the sides or tail. Albinism is rare, but melanism (black coloration) is fairly common. Once, black-phase gray squirrels were found throughout Pennsylvania; today, they occur most often in Warren, McKean, Potter, Forest, Elk, Cameron and Clinton counties. "Black squirrels" may be any shade from dark gray to nearly jet black, often with a brownish tinge. Gray squirrels eat mast--acorns, hickory nuts, walnuts, and beechnuts. Other foods include berries, mushrooms, pine seeds, corn (only the germ at the base of the kernel is eaten), and dogwood, wild cherry and black gum fruits. In early spring, squirrels eat buds, which are high-energy foods. Buds and flowers of red and sugar maples are eaten in April, and later the winged fruits of red maple may be eaten. These foods have a high moisture content that supplies squirrels' water needs, although they will drink from ground water sources if available. Grays smell out nuts which they bury for winter food. (Unrecovered nuts may sprout and grow into trees. In this way, squirrels help ensure continual forest growth.) Grays are probably the wariest of the Pennsylvania squirrels. They're quicker than fox squirrels and less vocal than reds, although they can sound warning barks and assorted "chucks." Hawks, owls, foxes and tree-climbing snakes occasionally kill young squirrels, but adults are not easily taken. Predators do not appreciably affect squirrel populations on good ranges--availability of food is the key to population size. A maximum life span for a wild gray squirrel could be 10 years or even longer, but few live more than two or three years. Grays live in nests and dens. They build leaf nests in trees near good food supplies in both summer and fall. Leaf nests, cooler than tree dens, are about 12x16 inches and built of twigs, leaves, grass, bark and other plant materials. Tree dens are often in cavities where limbs have broken off or in deserted woodpecker holes, usually 40-60 feet off the ground. Resident squirrels gnaw back the outer tree bark that, in time, would otherwise seal off the den holes. Gray squirrels breed in late winter-early spring. Following a 44-day gestation period, females bear litters of 4-5 young in late February, March or early April. The young are usually raised in tree dens and nursed by their mother for 5-7 weeks. Gray squirrels often bear a second litter in July or August, and small grays seen in autumn are from summer litters. Grays are gregarious and do not seem to demonstrate territoriality. Three or four individuals may feed side by side where food is plentiful.

Fox Squirrels - Fox squirrels are found mainly in the western and southern parts of the state. Unlike grays, fox squirrels prefer open, park-like woods with sparse ground cover, usually avoiding mountains and extensive forests. Their nesting, denning and feeding habits are much like those of gray squirrels. Fox squirrels have gray to reddish-gray upper parts and buff to pale orange-brown undersides. Larger than grays, weighing nearly two pounds, they are slower, more sluggish and less vocal. They are about 21 inches in length, including a 10-inch tail. Like the other Pennsylvania tree squirrels, fox squirrels never actually hibernate in winter but will hole up and sleep soundly through several days of snowstorms or extreme cold. Mating season is in January, and

young are born in late February or early March. Average litter size is 2-4 young; only one litter is raised per year. Fleas, chiggers and mosquitoes may bother squirrels, and tapeworms have been found in some specimens. Fox and gray squirrels seem to get along together wherever their ranges overlap.

Red Squirrels - The red squirrel is alert, raucous and energetic. About half the size of the gray, the red measures about a foot from nose to tail-tip and weighs about 5½ ounces. In summer its fur is a rich, rusty brown, turning grayer in winter, when it also develops prominent ear tufts. The undersides are off-white. The red squirrel is sometimes called a chickaree or a pine squirrel, reflecting its preference for nesting in conifers; reds are found most often where there are some evergreens. Behavior, feeding habits and denning practices are generally similar to those of gray and fox squirrels, although reds sometimes nest in holes at the base of trees. They enjoy eating the cones of white pine in the green state. Unlike fox and gray squirrels, reds do not bury nuts singly, preferring a large cache--often in a hollow log--for storing food. The breeding season for red squirrels begins in late winter, with 3-6 young born in April, May or June after a 40-day gestation period. Red squirrels have strong territorial instincts, often defending food sources and den trees against intrusion. The story that red squirrels castrate gray squirrels is untrue, although reds will aggressively drive off trespassing grays.

Flying Squirrels - Of the four Pennsylvania squirrels covered by this fact sheet, only the flying squirrel is nocturnal. This squirrel is about 8½ inches in length, including a 3½-inch tail. Its large eyes are adapted for night vision. The fur of the flying squirrel is very soft and grayish-brown in color, with the underparts white. The so-called flying membrane is a loose flap of skin between the fore and hind legs on either side of the body; this is stretched taut when the legs are extended, allowing the animal to soar or glide but not fly in the true sense of the word. The broad, flat tail is used as a rudder while the animal is airborne. A flying squirrel can sail up to 40 yards in a downward direction, often soaring from tree to tree. This squirrel is almost completely arboreal, rarely being seen on the ground. There are two species in Pennsylvania, but they differ little in appearance. Flying squirrels are not rare, but as they are nocturnal they are not often seen. They nest in hollow tree limbs and woodpecker cavities. Two to six young are born in April or May following a 40-day gestation period, and some biologists believe a second litter may be produced in July or August. Feeding habits are like those of other Pennsylvania squirrels.

POPULATION

Once there were so many gray squirrels in Pennsylvania that they were considered nuisances by pioneering farmers. In fact, bounties were paid on 640,000 squirrels in 1749, and many more were doubtless taken for the table. Settlement and development of our state has changed the habitat, and squirrel numbers have decreased since the 18th century--even so, there is no shortage of squirrels in Pennsylvania today. In 1973, our state's hunters took approximately 2,092,000 gray squirrels, making them the second most heavily harvested small game species. Biologists estimate that a healthy autumn squirrel population is composed of approximately 35 percent juveniles, 30 percent sub-adults and 35 percent adults; also, that one gray squirrel per acre of woodland is a good density and that three per acre is excellent and only occurs on prime habitat. Although a hundred or more squirrels may thrive in a park or campus, these situations do not occur in the wild. Should food become scarce in the wild, large segments of the gray squirrel population may leave their home locales, travel in search of food and concentrate where they find it. Squirrel populations fluctuate. Good reproduction--with most females bearing two litters--follows autumns in which large mast crops were produced. Severe winters, on the other hand, may reduce squirrel numbers, especially if they follow a mast failure.

HABITAT

Woodland areas can be managed to favor squirrels. Of the two main forest types found in Pennsylvania--oak-hickory in the south and beech-birch-maple in the northern sections of the state--the oak-hickory forest is better squirrel habitat, mainly because it has a greater variety of vegetation types. Gray squirrels prefer a deciduous forest with a variety of tree species which provide a varied food supply. A forest of mixed maples, oaks, hickories and beech, for instance, would support more grays than would a ridge-top stand of chestnut oaks. The fox squirrel needs woodland "edge"--places where the trees border corn or other crop fields. Good squirrel woods feature many mature mast-producing trees, a mixture of other tree and shrub species to provide seasonal food variety, natural den trees and hollow tree cavities for escape purposes. Diverse tree and shrub species ensure adequate food supplies even though weather, tree characteristics or tree vigor may cause food crop failure of some types

of vegetation. When the mast crop is poor squirrels may have a hard time finding sufficient food, and a food shortage preceding a severe winter can result in death or poor reproduction the following spring. Red, black and scarlet oaks regularly produce mast, while white and chestnut oaks are less reliable. Although white oak makes better sawtimber, the red oak group should generally be favored if the landowner wishes a large, stable squirrel population. In selective logging operations, four to six hickories should be left per acre (if they are available), as they are heavy mast producers. Old, hollow trees with many openings are rarely used for dens, although they provide temporary shelter from predators and hunters. A good den is usually a tree nearing maturity which has one or two openings into a cavity. Entrance holes are round and seldom over three inches in diameter. If a timber tract is to be managed for squirrels, at least four or five active den trees should be kept on each acre if possible. In forests where trees have reached a mast-producing stage but are not mature enough to serve as good den sites, artificial nesting boxes may be used.

NOTE: Presently thirty-two wildlife notes are available free of charge from the Pennsylvania Game Commission, and several more are being planned for the future. Of special interest to you will be the list of Game Commission educational materials - both free and paid - found in the back of this publication.

DAY VII: **Wildlife Habitat**

PURPOSE: To recognize the inseparable relationship between wildlife and their habitat.

SKILL AND ATTITUDE OBJECTIVES:

(1) To understand how local habitats affect the wildlife populations of an area.

(2) To understand the phrase "wildlife is a product of land".

(3) To be aware that habitat loss is the greatest threat to our wildlife resources.

MATERIALS: "Wildlife--The Environmental Barometer"

by: Wildlife Management Institute
709 Wire Building
Washington, D.C. 20005

READING: **Wildlife Habitat**

Wildlife is a product of land.

Summarizing the dynamics of our wildlife resources in such a concise manner can be misleading, yet understanding that statement is an important link in the chain of events that control life on this earth. So let's expand that thought to include a few particulars.

Agriculturally, we can easily observe ways in which plants respond to the soil. Soil moisture, temperature and nutrients are just a few variables that influence the life cycle of plants. Their growth, from seed to maturity, can be monitored in a flower box, cornfield, or a woodlot. Since plants are immobile, their growth patterns can hardly escape our notice. Young corn seedlings erupting from a recently sown field catch our attention, as does the wheat as it turns from green to gold. Not only are we supplied with much needed crops, but we also derive personal satisfaction from knowing our efforts produced them.

Wildlife, too, responds to land much like plants; but since animals are mobile we cannot expect to see them at an exact location or precise time each day. The doe and her twin fawns we saw this morning will probably not be there tomorrow at the same time. And the pileated woodpecker drilling an old den tree may not wait for us to take a photograph. Those same species are, however, very much dependent upon the land where they reside, for it is the plants which are found there that provide them with food and cover--two critical needs of every wild animal.

By manipulating the vegetation on a tract of land we are in effect determining the wildlife residency, for wildlife is truly a "product of the land."

Consider "Wildlife--The Environmental Barometer" and use these questions as a basis for classroom discussion.

1. What wildlife species in Pennsylvania act as environmental barometers? (If there were only a few deer killed on our highways this would be a good indicator something has happened to our deer herd; or, if we didn't see any geese migrating in the spring and fall there could be concern. Many possible examples--just be sure indices used as a basis of discussion are valid.)

2. At this point the unit should be evolving into some local concerns relating to wildlife habitat. Use this time to channel those concerns into classroom discussions.

WILDLIFE - THE ENVIRONMENTAL BAROMETER

HABITAT DETERMINES WILD POPULATIONS

Fish and wildlife are highly sensitive to environmental change. Alter stream temperature or flow, drain wetlands, channel natural water-courses, clear forests or make other changes that limit their food, water, or shelter and fish and wildlife are immediately affected.

The composition and condition of fish and wildlife populations serve as a barometer of the quality of the environment for man, because he too must have clean water, fertile fields, and healthy forests. Consequently, proper use of our nation's land and water resources is in the interest of man and of the fish and wildlife he enjoys.

Nearly every wild fish, bird or mammal has a comparatively narrow range of environmental elements that determines its survival. These may be divided broadly into food, water, and cover. But, every species' need for each of these essentials differs to some degree from those of others.

Some desert animals, like the kangaroo rat, require little or no obvious water supplies; they have become adapted through evolution to obtain their moisture requirements directly from plants. At the other extreme, waterfowl and aquatic mammals, like the muskrat and beaver, need an abundance of water--not only for drinking but as part of their cover requirements and to promote the growth of their essential foods. Some species, like the pronghorn antelope, must have open grassland; others, like the deer, thrive in mixtures of brushland and young forest.

Climate, topography, and geology in a given area are basic influences on the composition of the plant community, and the nature and abundance of the local plants, in turn, govern the kinds of wild animals that the area can support.

Man-made changes in the environment need not be destructive of wildlife in general, although they may alter radically the composition of the wildlife population. Felling an isolated woodlot and replacing it with corn, for example, will eliminate gray squirrels but may improve conditions for pheasants. Flooding the entire cornfield would drive out pheasants but create useful habitat for ducks and muskrats. Altering or maintaining the environment to favor the needs of certain wild species, in fact, is a basic technique of wildlife management.

MAN -- A MAJOR ENVIRONMENTAL FACTOR

Some environmental changes, however, may be extremely damaging to all wildlife. Excessive pollution, repeated uncontrolled forest fires, and farming and forestry practices that destroy soil fertility and the diversity of the plant community can create wildlife deserts.

When the balance between wildlife and its habitat is recognized, it is possible to understand why some species that never were hunted extensively became extinct while others that have been hunted intensively are among our most abundant species. The white-tailed deer, for example, is many times more abundant today than it was in 1900, and in most places more numerous than in 1600. Few of the birds and mammals listed as rare and endangered by the U.S. Bureau of Sport Fisheries and Wildlife ever were hunted. Most are victims of pollution, landfilling and clearing and other massive man-made environmental changes that have destroyed one or more essential elements in their habitat.

The transformation of America from wilderness to an urban-dominated landscape has brought great changes in the composition of the native wildlife. Species like the woodland caribou and ivory-billed woodpecker, which require habitats supplied only by wilderness, inevitably declined. But their places usually were taken by other species better adapted to an environment shaped by man, but, like the starling, not always as well liked by man.

When desirable wildlife begins to disappear from a given area, in spite of legal protection, it is an indication that something is wrong with the environment. And the effects on human beings may extend far beyond the loss of esthetic and recreational values.

The basic needs of wildlife are essentially the same as those of man. Most species of wildlife are products of a clean, fertile, and productive environment. They must have adequate food, clean water and protection from the elements if they are to survive. So must man.

Wildlife needs variety in its habitat in order to exist. So, too, does man, but perhaps on a larger scale.

Even the most urban-oriented citizen, who rarely ventures from the asphalt and concrete of modern Metropolis, needs a constant supply of uncontaminated water, meat from ranches and rangelands, produce from farms, fish from seas and estuaries, and paper pulp from forests. Although he may not think of them in such terms, these far-flung natural and cultivated areas are essential parts of the habitat of modern man.

The lands and waters that produce these commodities also harbor the bulk of our wildlife, and their capacity to support fish, birds and mammals is a good indicator of their capacity for meeting the basic needs of man.

WILD LANDS HAVE HUMAN VALUES

Most modern Americans are only beginning to recognize their close bonds with the natural world. A sign of this is found in changing attitudes toward swamps, marshes, and tidal estuaries. Until recently, these wetlands, cherished only by sportsmen and naturalists, generally were considered worthless until drained or filled. Unfortunately too many people still consider that their highest economic use is to serve as dumping grounds for the solid and liquid wastes of cities and industries.

The effects of this negative attitude have been apparent to sportsmen and wildlife scientists for many years. Marshes that once teemed with songbirds, shorebirds, waterfowl and a variety of mammals, their waters clouded by noxious bacteria and algae, now support little but starlings and rats. Many wetlands have disappeared completely under the avalanche of human expansion.

So what?

Are not housing and factory sites, airports and highways, and even convenient dumps more valuable *to people* than a few ducks, herons, muskrats, and songbirds? Perhaps to a few, but today's outcries of concern make clear that people are seeking effective ways to halt the accelerating destruction of their environment.

Unspoiled tidal marshes rank in economic productivity above the best prairie croplands. Marsh-rimmed estuaries are vital to the more important commercial marine fishes and to crabs, shrimps, and shellfish. Continued destruction of tidal wetlands threatens a major source of human food and the livelihoods of many people. A study of tidal bays and estuaries in Massachusetts revealed the presence of 84 species of fish at some stage in their life cycles.

Inland ponds, potholes, and marshes--vital breeding grounds for waterfowl and natural refuges for many other forms of wildlife--also have important economic values. In many places they are essential functioning units of the natural recharging of underground water supplies--vital to local agriculture, industry and human existence.

Oil spills and their immediate effects on wildlife have stirred great public indignation in the past few years. But run-away oil slicks are only the more obvious signs of a far greater problem.

Much of the pollution that originates on the land finds its way to the seas--pesticides carried by the air or washed into rivers, chemical wastes from factories, detergents from laundries and kitchen sinks, untreated

sewage, water-soluble solids dumped offshore, carbon dioxide from heating plants, and lead and carbon monoxide from motor vehicles and aircraft.

POLLUTION -- A THREAT TO WILDLIFE AND MAN

The effects of this constant and increasing contamination of the air and oceans are already apparent. Some wild species have declined dramatically. The brown pelican has all but disappeared as a breeding species on much of the Pacific Coast and around the Gulf of Mexico. There has been a sharp decline in the nesting success and numbers of bald eagles and ospreys in eastern United States. All of these birds feed heavily on fish, which absorb the persistent pesticides and store them in their tissues. DDT is considered a major culprit in the decline of these birds, as it is in the virtual extinction of the peregrine falcon in eastern North America.

A chilling threat--not only to wildlife but to all life is seen by some scientists today in the cumulative effects of pollution on the oceans. Marine phytoplankton are the bases of food chains in the seas. Without these microscopic plants, all ocean life from the smallest shrimp to the largest whales would perish. Moreover, phytoplankton have approximately three time as much gross capacity for converting carbon dioxide to usable oxygen as all land plants combined. Their present abundance is essential, these scientists believe, to maintain the oxygen content of the atmosphere at a level that will support life.

But phytoplankton are extremely intolerant of acidity and trace elements, which are common in most pollutants, including pesticides. When carbon dioxide--a near universal by-product of human activity--is absorbed by sea water in quantities beyond those that marine plants can readily convert to oxygen, it creates an acid condition that kills the phytoplankton. Trace elements in other pollutants cause the death of more. If too many die, according to this sobering theory, the oxygen content of the atmosphere will fall, and Earth will become another dead planet.

THE TREND CAN BE REVERSED

How far down the line the world has progressed toward this grim end, no one is sure. But the rising quantities of carbon dioxide in the atmosphere and the fact that DDT has been found in the tissues of Arctic polar bears, Antarctic penguins, and many wild species between the poles are warnings of a possible trend in that direction.

The trend can be reversed, if Americans and people of other nations have the will, intelligence, and prudence to act promptly and vigorously to cure the Earth's environmental ills. Wildlife that is threatened by air and water pollution and by the destruction of essential vegetation, soil erosion, and a general degradation of the environment can be saved.

By saving wildlife man may save himself.

ARROWHEAD

DAY VIII: Habitat Diversity and Limitations

PURPOSE: To repeat the field walk of Day III and examine the ecosystem more critically in terms of habitat.

SKILL AND ATTITUDE OBJECTIVES:

(1) To recognize habitat types and why they are suited for particular wildlife.

(2) To be able to describe why certain animals are not present on the study area.

(3) To be aware that these concepts can be applied to other locations.

(4) To be aware that human impact on the environment limits the future of some forms of wildlife.

MATERIALS: Pencils and note pads
(Alternative) Toothpicks or matches

ACTIVITY: Field Walk (Part II)

Repeat the field walk of Day III looking more specifically this time at habitat diversity and the limitations of this area. Encourage the students to review their notes from the previous walk.

Consider the following:

1. What forms of wildlife were present fifty years ago?
2. Are they present today? If not, why not?
3. What forms of wildlife might be missing in the future? Why?
4. Can anything be done to prevent wildlife habitat from being destroyed?
5. What is the value of your local wildlife population to your community?
6. Can these values be measured only in terms of dollars?

Try to discuss these topics outside, during the walk, where the atmosphere is more conducive to the problem.

(Alternative): Natural History Study -- Day VI

There are at least two alternatives at this point. The first is the Natural History Study described as the alternative to Day VI, or consideration of the ultimate wildlife-human problem--people density.

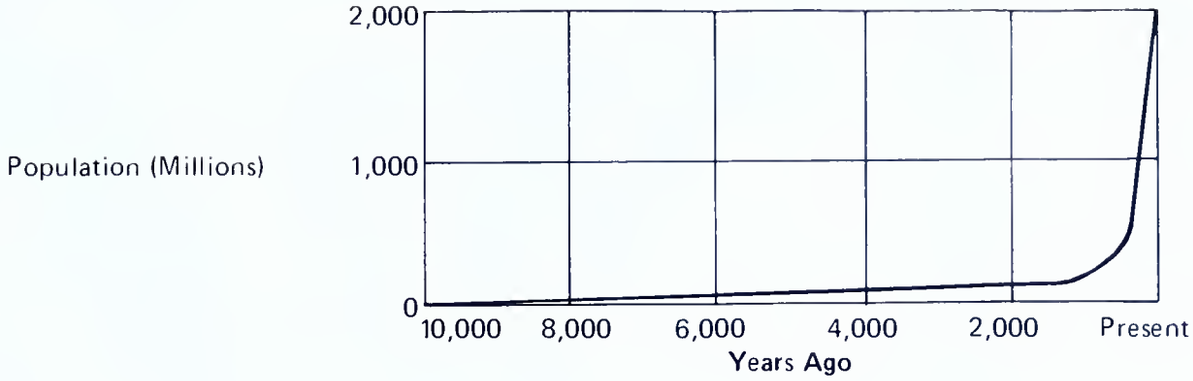
POPULATION ESTIMATES ACCORDING TO U.N. "CONSTANT FERTILITY, NO MIGRATION,"

1960 - 2000, in Major Areas of the World
(Population in thousands)

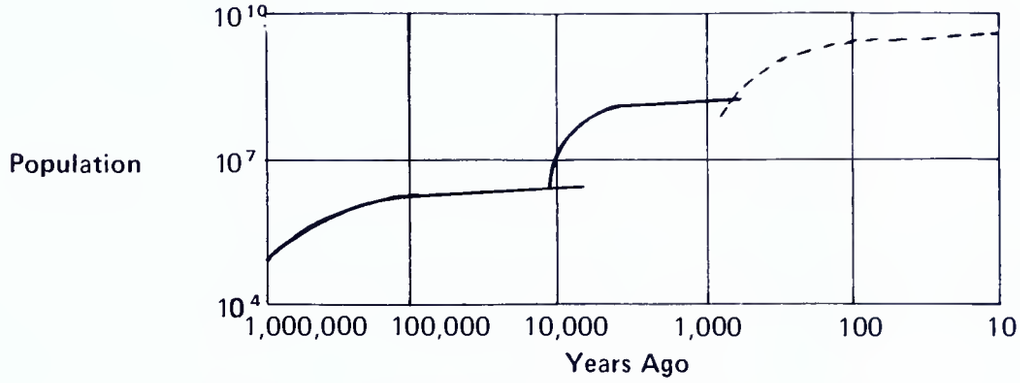
Major areas and regions	*1960*	*1965*	*1970*	*1975*	*1980*	*1985*	*1990*	*1995*	*2000*
World Total	2,998,180	3,297,482	3,640,970	4,042,761	4,519,146	5,088,112	5,763,577	6,564,584	7,522,218
More developed regions[a]	976,414	1,037,209	1,100,340	1,168,202	1,241,660	1,319,857	1,401,980	1,488,187	1,580,049
Less developed regions[b]	2,021,766	2,260,273	2,540,630	2,874,559	3,277,486	3,768,255	4,361,597	5,076,397	5,942,169
A. *East Asia*	794,144	863,258	942,256	1,034,364	1,142,609	1,272,236	1,424,527	1,601,016	1,810,678
1. Mainland region	654,181	711,000	776,000	852,000	942,000	1,051,000	1,180,000	1,330,000	1,509,000
2. Japan	93,210	98,011	103,341	108,861	114,055	118,457	121,809	124,809	127,160
3. Other East Asia	46,753	54,247	62,915	73,503	86,554	102,779	122,579	146,207	174,518
B. *South Asia*	865,247	975,940	1,105,563	1,259,456	1,446,153	1,674,235	1,952,050	2,290,246	2,701,865
4. Middle South Asia	587,277	660,148	746,062	848,430	972,506	1,123,880	1,308,534	1,534,394	1,811,220
5. South-East Asia	218,866	248,641	282,523	322,149	370,409	430,006	502,966	590,983	696,620
6. South-West Asia	59,104	67,151	76,978	88,877	103,238	120,349	140,550	164,869	194,025
C. *Europe*	424,657	442,416	460,136	478,209	496,448	514,820	533,108	551,655	570,785
7. Western Europe	134,536	139,157	143,583	148,036	152,284	156,621	161,183	166,123	171,520
8. Southern Europe	117,488	123,273	129,224	135,221	141,304	147,498	153,492	159,291	164,962
9. Eastern Europe	96,852	101,654	106,234	111,105	116,313	121,475	126,498	131,411	136,213
10. Northern Europe	75,781	78,332	81,095	83,847	86,547	89,226	91,935	94,830	98,090
D.11. USSR	214,400	233,411	252,498	272,415	294,594	318,896	345,084	372,800	402,077
E. *Africa*	272,924	306,563	347,791	397,830	458,251	531,213	619,748	728,013	860,462
12. Western Africa	85,973	98,535	114,007	132,973	156,165	184,631	219,799	263,572	317,915
13. Eastern Africa	75,032	82,120	90,910	101,579	114,355	129,384	146,976	167,803	192,725
14. Middle Africa	28,345	30,559	33,303	36,578	40,444	45,001	50,389	56,832	64,427
15. Northern Africa	65,955	75,351	86,712	100,408	116,884	136,843	161,215	191,104	227,748
16. Southern Africa	17,619	19,998	22,859	26,292	30,403	35,354	41,369	48,702	57,647
F.17. *Northern America*	198,664	213,840	230,409	249,840	272,238	297,348	324,955	354,914	388,264
G. *Latin America*	212,431	245,080	283,899	330,488	386,856	455,131	537,450	636,447	755,579
18. Tropical South America	112,479	131,334	153,838	180,933	213,792	253,728	302,118	360,626	431,302
19. Middle America (mainland)	46,811	54,926	64,775	76,878	91,921	110,535	133,312	161,037	194,816
20. Temperate South America	32,796	35,896	39,287	43,018	47,123	51,647	56,587	61,966	67,786
21. Caribbean	20,345	22,924	25,999	29,659	34,020	39,221	45,433	52,818	61,675
H. *Ociania*	15,713	16,974	18,418	20,159	21,997	24,233	26,655	29,493	32,508
22. Australia and New Zealand	12,687	13,635	14,669	15,859	17,202	18,689	20,298	22,043	23,977
23. Melanesia	2,166	2,339	2,549	2,800	3,095	3,444	3,857	4,350	4,931
24. Polynesia and Micronesia	860	1,000	1,200	1,500	1,700	2,100	2,500	3,100	3,600

[a] Including Europe, the USSR, Northern America, Japan, Temperate South America, Australia and New Zealand.
[b] Including East Asia less Japan, South Asia, Africa, Latin America less Temperate South America and Oceania less Australia.

Population Growth



Arithmetic population curve plots the growth of human population from 10,000 years ago to the present. Such a curve suggests that the population figure remained close to the base line for an indefinite period from the remote past to about 500 years ago, and that it has surged abruptly during the last 500 years as a result of the scientific-industrial revolution.



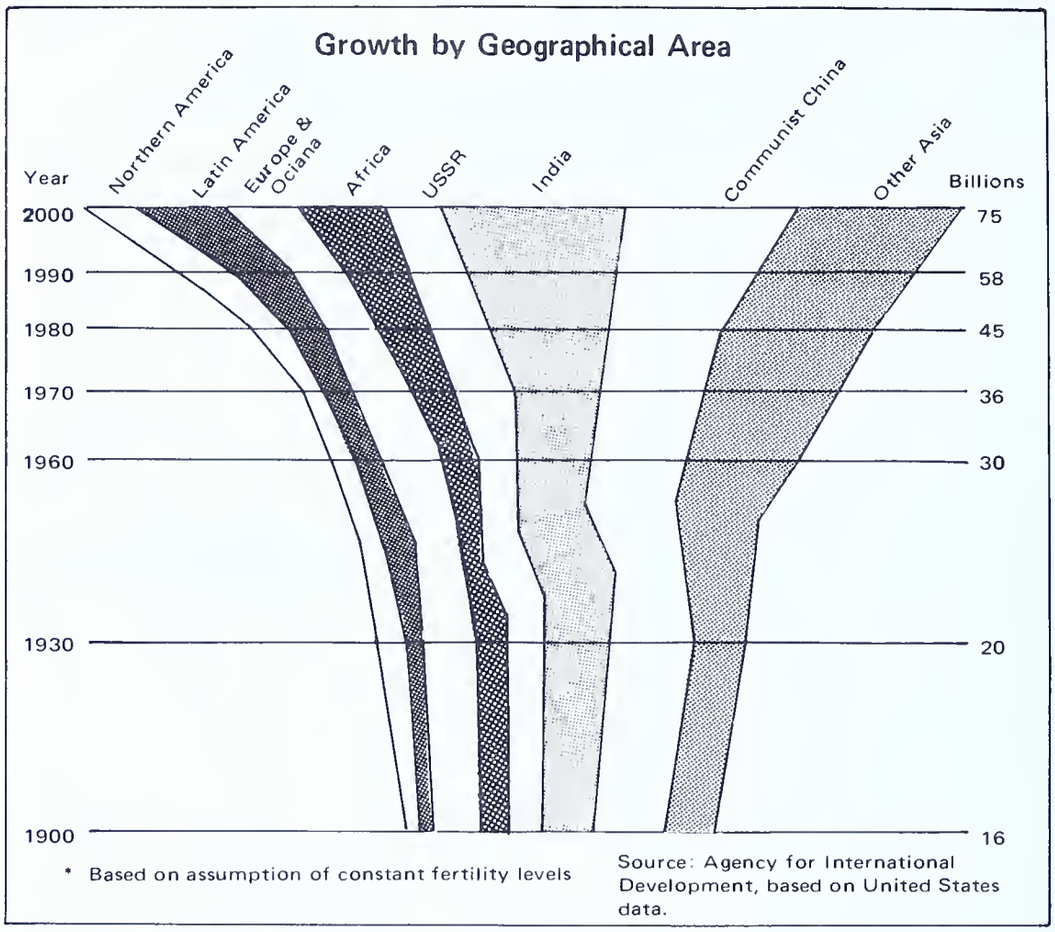
Logarithmic population curve makes it possible to plot, in a small space, the growth of population over a longer period of time and over a wider range. Curve, based on assumptions concerning relationship of technology and population as shown in chart, reveals three population surges reflecting toolmaking or cultural revolution, agricultural revolution, and scientific-industrial revolution.

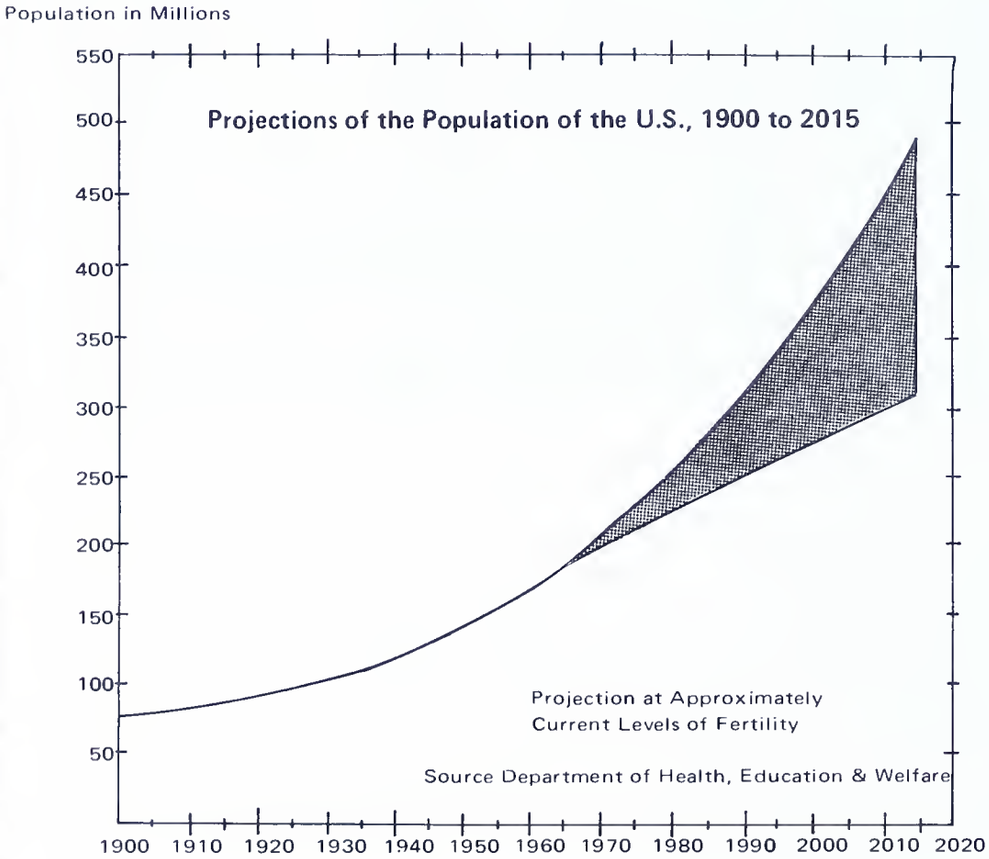
The above graphs from **Scientific American**, September 1960. "The Human Population," by E. S. Deevey, Jr. Used by permission.

In the Year 2000: Where the People Will Be

	Millions	
	1969*	2000
Northern America	226	388
(United States)	(204)	(350)
Latin America	275	756
Europe	456	571
Ociana	18	32
Africa	338	860
U.S.S.R.	248	402
India	542	1,259
Communist China	755	1,500
Other Asian countries	714	1,754
	3,572	7,522

*Preliminary





Within 70 years world population has more than doubled and is expected to double again by the end of the century. U.S. population, a little over 200 million in 1970, is expected to reach between 280 million and 370 million by the year 2000.

COPYRIGHT 1970 CONGRESSIONAL QUARTERLY INC.

Included are human population data that highlight the magnitude of the problem. Consider sheer numbers, reproductive potential and overconcentration.

Discuss the charts, making sure the students understand:

birth rates	--	No. of live births/1000 people
death rates	--	No. of deaths/1000 people
growth rates	--	Birth rate - death rate
fertility rates	--	No. births/1000 women ages 16-44

Use matches or toothpicks to show geometric (1,2,4,8,16..) and arithmetic (1,2,3,4..) progression.

Conduct an in-class survey on the size of the student's existing families, the proposed sizes of their future families and the environmental cost (especially in terms of wildlife habitat) of each added birth to their communities.

DAY IX: Wildlife Management

PURPOSE: To consider wildlife management as a positive tool to be used in conserving our wildlife resources.

SKILL AND ATTITUDE OBJECTIVES:

(1) To be able to define wildlife management.

(2) To be able to recognize the application of wildlife management to our environmental problems.

(3) To be aware that wildlife--with few exceptions--interacts with man, and that scientific management holds the key to the welfare of wildlife resources.

READING: Wildlife Management

Wildlife management! To some, a cold sterile term connotating the artificial manipulation of our wildlife resources. But artificial is also relative. During Day III, a question was posed without an accompanying answer. Is man a natural part of an ecosystem? There is no simple or singular answer to that question, and the possibilities for discussion are almost infinite. Regardless, we must make some commitments toward wildlife and wildlife habitat, for natural or unnatural, man is here. His effects can be devastating or constructive.

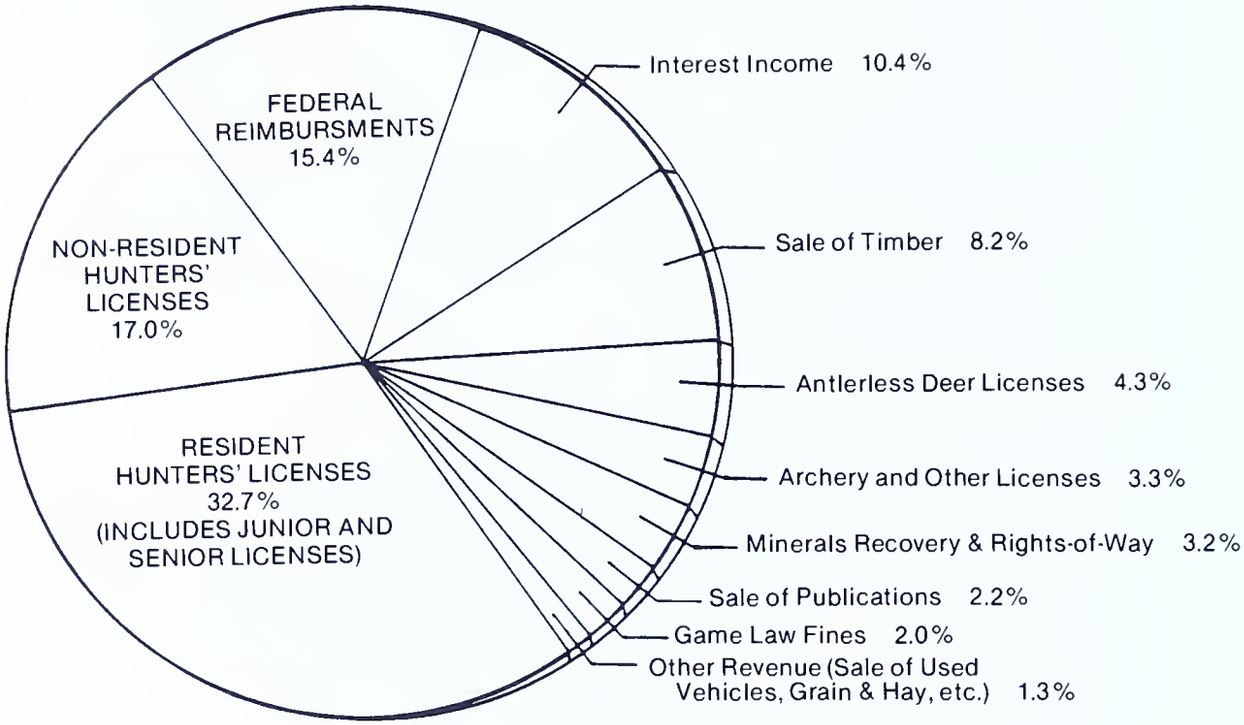
Let's consider wildlife management in the context of a real world: a world that demands much of our natural resources, a world that is ruled largely by economics, and a world that is concerned (some of us) with the future of wildlife.

Wildlife management is defined as the science and art of influencing characteristics and interactions of habitat, wildlife, and people, in order to achieve specific human goals by means of the wildlife resources. The principles of wildlife management are based on scientific research, but applying these principles to our technological society is truly an art.

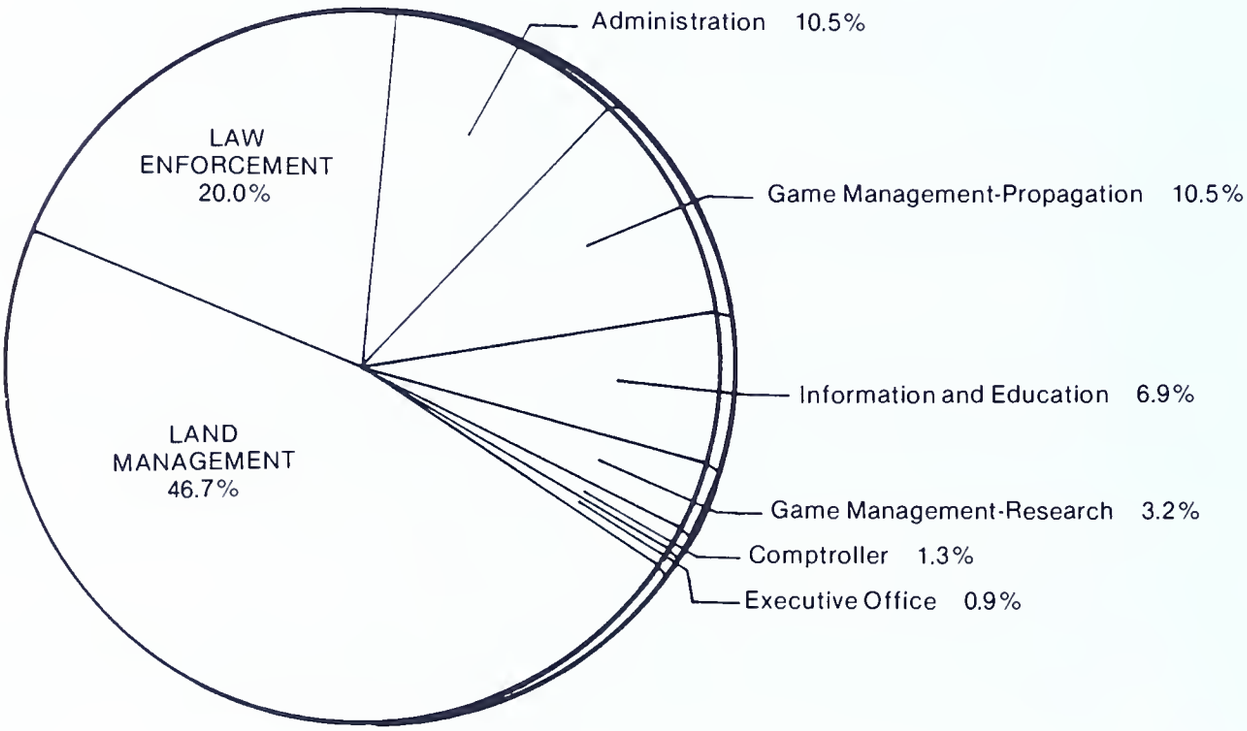
Various techniques are used to apply the principles of wildlife management to the ecosystems where humans and wild things interact. Censusing wild populations and monitoring any changes in their numbers, is an important task of biologists. Data collected enables administrators to establish harvest regulations, an important part of management. Law enforcement techniques further protect the resource. Another valuable technique involves manipulating habitat in order to accommodate certain species at various locations. Managing wildlife is a scientific process and takes the talents of different specialists to ensure the future of this valuable resource.

Many decisions will have to be made in the future regarding wildlife and wildlife habitat. In order to make these decisions, we will need basic information that must be uncovered through efficient research. The consequences of building a highway along or across a valley, or a marsh, or dredging a swamp, or applying chemicals to fields and large areas of land or water are but a few of the things we will need to evaluate. Some species are very sensitive to changes in their environment, and as intelligent beings, we must be sensitive to those realities.

GAME COMMISSION REVENUE
$28,085,206
JULY 1, 1980, TO JUNE 30, 1981



GAME COMMISSION EXPENDITURES AND COMMITMENTS $28,196,541
JULY 1, 1980—June 30, 1981



PENNSYLVANIA GAME COMMISSION—FINANCIAL ASSESSMENT

CURRENT AND PRIOR YEAR REVENUE COMPARISON

	July 1, 1980 to June 30, 1981	July 1, 1979 to June 30, 1980
Resident Hunting Licenses—Adult	$8,083,956	$7,816,683
Resident Hunting Licenses—Junior	771,940	770,104
Resident Hunting License—Senior	322,545	304,721
Non-resident Hunting Licenses	4,778,941	4,339,669
Anterless Deer Licenses	1,218,290	1,262,675
Archery Licenses	536,450	506,722
Muzzleloading Hunting Licenses	325,612	195,050
Rights of Way and Other Licenses and Permits	221,411	211,056
Game Law Fines	578,238	542,422
Federal Aid for Wildlife Restoration and Recreation	4,314,033	4,155,173
Interest on Securities and Deposits	2,915,575	2,765,988
Sale of Timber and Other Wood Products	2,292,929	1,730,325
Game News Subscriptions and Sale of Publications	563,684	647,480
Sale of Coal	595,816	293,834
Ground Rentals and Royalties from Gas and Oil	129,499	120,315
Reimbursement for Comptroller Services	—	346,174
Sale of Automobiles and Other Used Vehicles	59,850	84,425
Sale of Unserviceable and Non-Usable Property	29,880	13,438
Rental of State Property	9,624	10,108
Sale of Skins and Guns	73,354	56,383
Sale of Grain and Hay	73,480	83,290
Wildlife Management Promotional Revenue	44,527	36,616
Miscellaneous*	145,572	68,844
TOTAL REVENUES	$28,085,206	$26,361,495

* Miscellaneous consists of refunds for postage applicable to prior year expenditures and numerous items pertaining to operations on State Game Lands.

COMPARISON OF COMMITMENTS AND EXPENDITURES
Current and Prior Fiscal Years

	July 1, 1980 to June 30, 1981	July 1, 1979 to June 30, 1980
Salaries	$10,996,442	$10,958,863
Wages	1,032,341	863,844
Employee Benefits	4,214,932	3,796,597
Land Purchases and Acquisition Costs	3,225,093	2,681,449
Automotive Repairs, Supplies and Rentals	1,231,027	1,022,032
Printing and Advertising	1,070,577	1,009,739
Maintenance of Buildings and Machinery	869,777	792,261
Purchase of Trucks, Automobiles and Jeeps	763,229	573,781
Pheasant, Turkey and Duck Feed	679,288	695,386
Travel and Special Conference Expenses	398,909	343,412
Payment to Local Municipalities in-lieu-of Taxes	480,618	241,500
Payment to Other State Agencies		
Comptroller Services Rendered	357,497	—
Data Processing Services	—	62,286
Duplicating and Reproduction Services	—	59,874
Auditing Services	92,936	56,121
Personnel Services	32,687	36,994
Purchasing Services	19,542	35,856
Checkwriting and Disbursement Services	6,435	9,529
Postage	304,155	292,745
Purchase of Agricultural, Heavy and Other Equipment and Machinery	257,794	269,256
Telephone Expenses	269,294	260,084
Building Rentals and Land Rights-of-Way Leases	248,930	254,587
Heating, Power and Light	276,686	224,626
Legal, Appraisal and Consulting Fees	236,538	206,654
Wildlife Habitat Seedlings and Plantings	182,156	186,114
Office Equipment, Maintenance, Rentals and Supplies	103,574	164,873
Educational Supplies	104,213	151,870
Uniforms for Game Commission Personnel	157,434	109,713
Rental of Data Processing and Copying Equipment	127,299	104,880
Other Supplies (laboratory, ammunition, etc.) and Services	117,690	83,699
Radio Communications Equipment and Services	182,768	69,863
Wildlife Research Grants to Universities and Wildlife Associations	72,590	56,700
Insurance on Automobiles and Buildings	56,440	48,523
Payments to Individuals for Bear Damage and Deer Proof Fencing	25,650	33,301
GAME COMMISSION GENERAL OPERATIONS TOTAL	$28,194,541	$25,757,012
Replacement Checks, Treasury Dept.	2,000	2,000
TOTAL COMMITMENTS AND EXPENDITURES	$28,196,541	$25,759,012

Since the problems are complex, we will not want to make decisions hastily. Long range planning will be a necessity. Cooperation between public and private agencies and organizations will be essential if our goals for conserving our wildlife resources are to be achieved. Alternatives must be made available as the sacrifice or destruction of some habitat may be necessary in order to accomplish some other priority. The trade-off then becomes a deliberate choice rather than a heedless motion which may hold possible regrets and ultimate tragedy.

Our growing crises have been accompanied by a bewildering array of public policies and programs, many lacking the foundations of research. Good educational programs are essential as these decisions will require public support. And economic considerations will certainly surface.

For instance, let's look at the budget of the Pennsylvania Game Commission. The pie charts and revenue and expenditure figures represent many dollars. These funds are not generated through tax dollars. The citizens of Pennsylvania do not pay for the management of our wildlife resources unless they purchase a hunting license. This is a fact understood by few people. Realistically, these revenues could not be generated if it were not for the sportsmen. Discuss this economic reality.

Hunting, as a tool of wildlife management becomes an inescapable consideration. It is not our intent to make people hunters, but we do want people to be objective about their outlook towards hunting.

The final discussions should center around two sources--a pamphlet "Placing American Wildlife Management in Perspective," and the film "A Question of Hunting." It is imperative you preview these materials. We welcome any questions you may have concerning the subject. Introduce them to the class and throw out some leading questions.

1. What is hunting? (pp 11-13)*

2. What is the difference between market hunting and sport hunting? (pp 11-13)

3. Does hunting threaten any species with extinction? (pp 15-17)

**Page numbers correspond with the pamphlet "Placing American Wildlife Management in Perspective."*

DAY X: The Future of Wildlife

PURPOSE: To summarize the principles and concepts relating to our wildlife resources

SKILL AND ATTITUDE OBJECTIVES:

(1) To be able to describe, through this ten day experience, the basic ecological considerations of wildlife and the environment.

(2) To be aware of value judgments and how they relate to the conservation of our wildlife resources.

MATERIALS AND EQUIPMENT: "A Question of Hunting"

This film is available from your local District Game Protector.

ACTIVITY: Film - "A Question of Hunting"

The film illustrates the thoughts of both a preservationist and a conservationist and their feelings toward hunting as a tool used to manage our wildlife resources.

Discussion: The Future of Wildlife

The discussions of your group will be unique to your situation, thus setting specific guidelines are most difficult for this day. The questions of yesterday should now be answered, and corollary items considered. There are additional materials to be perused, some of which are listed on the following page; however, for the purpose of this teaching unit, the references cited should be sufficient. Consult the Conservation Directory (available from National Wildlife Federation, 1412 Sixteenth Street, N.W., Washington, D.C. 20036) for the addresses of different source listings.

Two frequently mentioned sources include:

The Wildlife Society
Suite 611
7101 Wisconsin Avenue, N.W.
Washington, D.C. 20014
Phone: 301-986-8700

The Wildlife Management Institute
709 Wire Building
Washington, D.C. 20005
Phone: 202-347-1774

As a teacher or group leader your responsibility is great. Education involves viewing all sides and angles of a problem. Presenting material in this fashion is a real challenge. We hope this information was of value to you and, as professional wildlife managers, we feel the conceptual understanding of this material is critical for the future of our wildlife resources.

RELATED READINGS:

Amory, C. 1974. *Man Kind?* Harper and Row, Publ., New York. 372 pp.

Applegate, J.E. 1973. *Some factors associated with attitudes toward deer hunting in New Jersey residents.* In J.C. Hendee and C. Schoenfeld, eds. *Human dimensions in wildlife, programs: reports of recent investigations.* Wildl. Manage. Inst. 191 pp.

Applegate, J.E. 1975. *Attitudes toward deer hunting in New Jersey: a second look.* Wildl. Soc. Bull. (in press).

Graham, A.D. 1973. *The Gardeners of Eden.* George Allen and Unwin Ltd., London. 246 pp.

Klein, D.R. 1973. *The ethics of hunting and the antihunting movement.* In J.C. Hendee and C.C. Schoenfeld, eds. *Human dimensions in wildlife, programs: reports of recent investigations.* Wildl. Manage. Inst. 191 pp.

Marx, W. 1970. *The Disney imperative.* In W. Anderson, ed. *Politics and Environment.* Goodyear Publishing Co., Pacific Palisades, Calif. 362 pp.

Mitchell, J. G. 1979. *The Hunt.* Alfred A. Knopf, Inc., New York. 243 pp.

Potter, D.R., J.C. Hendee, and R.N. Clark. 1973. *Hunting satisfaction: game, guns, or nature?* In J.C. Hendee and C. Schoenfeld, eds. *Human dimensions in wildlife programs: reports of recent investigations.* Wildl. Manage. Inst. 191 pp.

Samuel, E.D. 1974. *Gone hunting; the Bambi syndrome.* West Virginia Univ. Magazine 6(3): 18-23.

Shaw, D.L. and D.L. Gilbert. 1974. *Attitudes of College students toward hunting.* Presented to 39th North American Wildl. and Nat. Res. Conf., March, Denver, Colorado.

Stankey, G.H., R.C. Lucas, and R.R. Ream. 1973. *Relationships between hunting success and satisfaction.* In J.C. Hendee and C. Schoenfeld, eds. *Human dimensions in wildlife programs: reports of recent investigations.* Wildl. Manage. Inst. 191 pp.

Teague, R.D. 1971. *A manual of wildlife conservation.* The Wildl. Society, Washington, D.C. pp 41-47.

RESOURCE AIDS

The following materials (free and paid) are available from the Pennsylvania Game Commission, Box 1567, Harrisburg, Pa. 17120. Escalating costs make it necessary for us to charge the following postage and handling fees for reprint literature:

Single Titles

1 copy	Free
2-10 copies	$0.50
11-30 copies	$1.00
30-plus copies	Will be billed for 3rd. class plus 10%

Two or more titles will be subject to same charges as multiple copies of single publication.

Check or money order should be made payable to the Pennsylvania Game Commission.

FREE LITERATURE

After the Buck Season
American Woodcock in Pennsylvania
Antlerless Deer License Allocations
Beaver in Pennsylvania
Bronze Beauty of the Big Woods (Turkey)
Cottontail Rabbit
Deer Harvest Map
Deer Diseases and Parasites
Duck Identification Chart
Environmental Concern and Wildlife - a Humane Approach
50 Birds and Mammals of Pennsylvania
Get Your Geese in the Southeast
Hunting Facts of Pennsylvania
Hunting in: Northwest - Northcentral - Northeast Southwest - Southcentral - Southeast
Hunting is Big Business
Job With Wildlife, A
List of Protected Birds in Pennsylvania
List of Protected Mammals in Pennsylvania
Magic of Deer Antlers
Meet the Squirrel Family
Middle Creek for Wildlife and People
Nesting Boxes, Bird Houses - How to Build Them
Official Digest - PA Hunting & Trapping
Of Prey and Predators
Opossum, A Look at the
Organization & Responsibilities of the Pennsylvania Game Commission
Oriental Bombshell (Pheasant)
Our Man-Made Environmental Crisis
Parasites of Pennsylvania Deer
Pennsylvania Woodchuck
Plans for Wood Duck Nesting Box
Poison Ivy! Where?
Prickley Prince of the Pinegroves (Porcupine)

Pymatuning
Pymatuning Story
Ruffed Grouse
Shohola Waterfowl Management
Some Plants are Poison
So You Don't Like Venison
10 Commandments of Shooting Safety
To Field-Dress a Deer
Trapping and Wildlife Management
Ups and Downs of Rabbits
Vanishing Spitfire (Wildcat)
Venison Needn't be "Pot Luck"
What Do Deer Eat?
Whistlin' Robert - Bobwhite Quail
White-tailed Deer in Pennsylvania
Why A Spring Gobbler Season?
Why Use the Steel Trap?
Wildlife Conservation History
Wildlife Crossword Puzzle
Wings Out Your Window (Birds - Food & Cover)
Wildlife Notes on:
- Beaver
- Black Bear
- Bobcat
- Bobwhite
- Canada Goose
- Chipmunk
- Cottontail Rabbit
- Crows and Ravens
- Doves
- Eagles and Osprey
- Foxes (Red & Gray)
- Heron
- Minks & Muskrats
- Opossum
- Otter
- Owls
- Porcupine
- Raccoon
- Raptors
- Ring-Necked Pheasant
- Ruffed Grouse
- Shrews
- Squirrels
- Striped Skunk
- Varying Hare
- Vultures
- Weasels
- White-tailed Deer
- Wild Turkey
- Woodchuck
- Woodpecker
- Woodcock

PAID MATERIALS:

GAME NEWS SUBSCRIPTION PRICE
3 Years ($10.50); 1 Year ($4.00)

Bird and Mammal Charts (Size 20″ x 30″)
Set #1—4 Charts ($4.00); Set #2—4 Charts ($4.00);
Set #3—8 Charts 11″ ($4.00)

Symbol Chart (State Animal, Bird, Tree and Flower)
$2.00

GAMES NEWS Cover Prints ($4.00) 11″ x 14″ colored prints of: Doves, Buck & Doe, Woodcock and Woodchuck. (4 Prints)

GAMES NEWS Binders ($3.50)

Wildlife Placemat ($2.50)

SPORT Patch ($1.00)

Hunting Caps ($4.00)
(Fluorescent Orange)

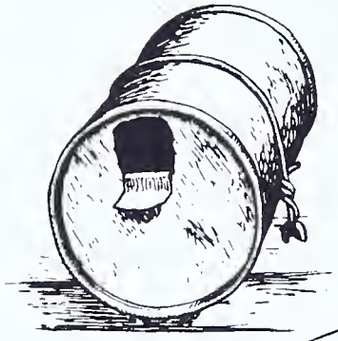
Books
Pa. Trapping Manual ($3.00)
White-Tailed Deer in Pennsylvania ($2.00)
Pennsylvania Birdlife ($4.00)
Gone for the Day ($4.00)
Mammals of Pennsylvania ($4.00)
Big Game Records (1965-1976) ($2.00)
Ducks at a Distance ($1.00)
Wild Game Cookbook ($2.50)
Woodlands and Wildlife ($2.00)
GAME NEWS Treasury ($7.50)
(Soft Cover)

A 20% discount will be allowed educational institutions only for bulk orders (10 or more copies of a single title) to permit and encourage use of the publications as textbooks. The discount does not apply to charts, cover prints, binders, placemats, SPORT patches, or hunting caps. Tax and postage included in price. Send separate checks for: GAME NEWS subscriptions, hunting licenses, and paid materials.

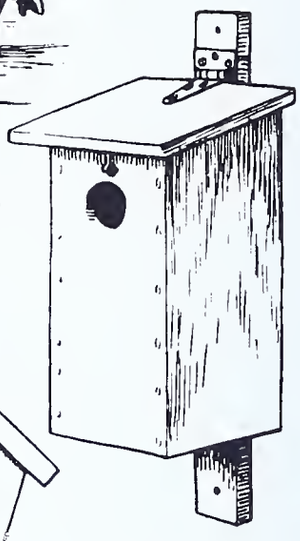
HELP PROVIDE HABITAT

Once a common sight in the Pennsylvania countryside, the bluebird has dwindled in the past half century. Among the many reasons for its decline are loss of tree cavity nesting spots, and the competition for the few sites from house sparrows and starlings. Many outdoors people erect suitable bluebird nest boxes in an effort to bring back this lovely little bird with the voracious appetite for insects. Boxes must be the exact size to let bluebirds in and keep competitors out. Favorite habitat is open farmland and roadsides.

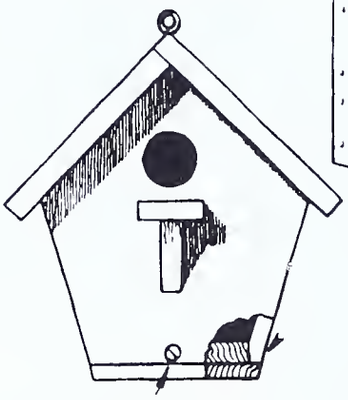
You can help the bluebird and other cavity nesting birds by having your classes build nesting boxes and then placing them in suitable habitat.



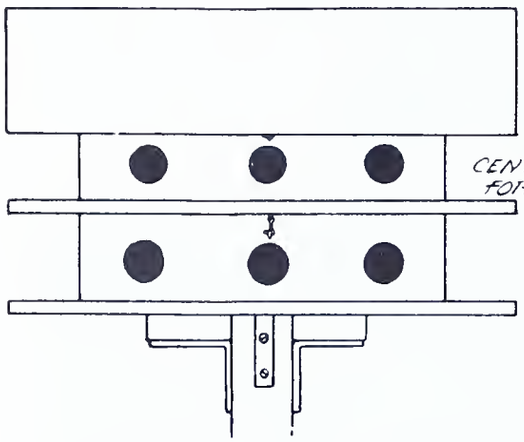
TIN CAN WREN HOUSES SHOULD BE PLACED IN A SHADY LOCATION TO PREVENT OVERHEATING



BLUEBIRDS LIKE THIS BOX WITH THE HINGED ROOF

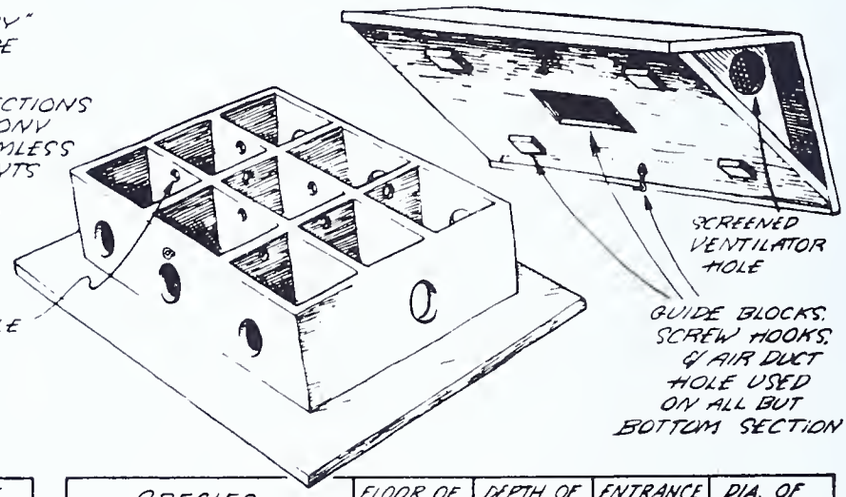


2 SCREWS SECURE THE FLOOR OF THIS WREN HOUSE. ONLY BOXES INTENDED FOR WRENS & MARTINS SHOULD BE HUNG FROM LIMB; OTHERS TO BE FASTENED SECURELY TO A POST OR TREE TRUNK.



"ADD-A-STORY" MARTIN HOUSE

ADDITIONAL SECTIONS ADDED AS COLONY GROWS. BOTTOMLESS CENTER COMPARTMENTS FORM AIR DUCT TO VENTILATED "ATTIC".



5/16" HOLE

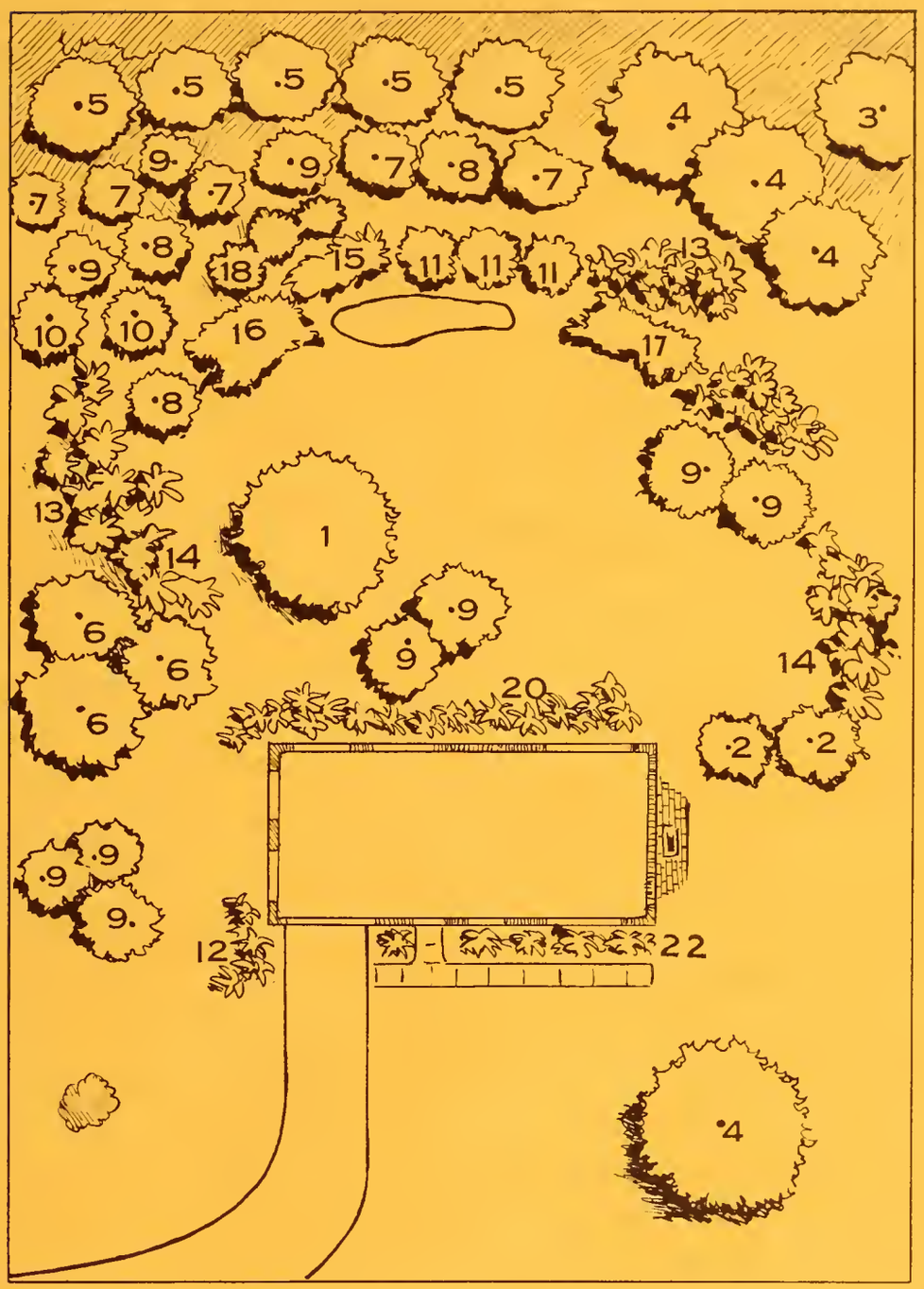
SCREENED VENTILATOR HOLE

GUIDE BLOCKS. SCREW HOOKS. & AIR DUCT HOLE USED ON ALL BUT BOTTOM SECTION

SPECIES	FLOOR OF CAVITY	DEPTH OF CAVITY	ENTRANCE ABOVE FLOOR	DIA. OF ENTRANCE
BLUEBIRD	5"x5	8	6"	1½"
CHICKADEE	4"x4"	8-10	6-8	1⅛
TITMOUSE	4"x4"	8-10	6-8"	1¼"
NUTHATCHES	4"x4"	8-10	6-8"	1¼"
HOUSE WREN	4x4	6-8"	1-6"	⅞
CAROLINA WREN	4x4"	6-8"	1-6"	1⅛"
CRESTED FLYCATCHER	6"x6"	8-10"	6-8"	2"

SPECIES	FLOOR OF CAVITY	DEPTH OF CAVITY	ENTRANCE ABOVE FLOOR	DIA. OF ENTRANCE
FLICKER	7x7"	16-18"	14"-16"	2½"
RED HEADED WOODPECKER	6x6"	12-15"	9"-12"	2"
DOWNY WOODPECKER	4"x4"	8-10"	6"-8"	1¼"
PURPLE MARTIN	6"x6	6"	1"	2½"
TREE SWALLOW	5x5"	6"	1"-5"	1½"
BARN OWL	10"x18	15-18"	4"	6"
SPARROW HAWK	8x8"	12"-15	9"-12"	3"

BACKYARD WILDLIFE PLANTING PLAN



LARGE TREES - (1) beech; (2) holly; (3) white oak; (4) red maple; (5) white pine; (6) white spruce; (7) hemlock; SMALL TREES - (8) mountain ash; (9) flowering dogwood; (10) crabapple. LARGE SHRUBS - (11) winterberry; (12) downy service berry; (13) autumn olive; (14) viburnum; (15) elderberry. SMALL SHRUBS - (16) blackberry; (17) silky doogwood; (19) Tartarian honeysuckle; (20) snowberry; (21) Japanese barberry; (22) rhododendron or other ornamental suitable to site. FLOWERS for planters and scattered beds - asters, daises, marigolds, petunias, black-eyed Susan's, sunflowers.

HELP PROVIDE HABITAT

WERT
BOOKBINDING
MIDDLETOWN, PA.
AUG. 83